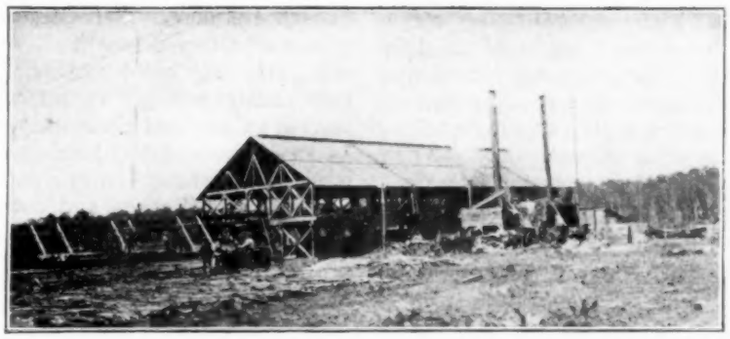
April 24, 1919 American Machinist Vol. 50, No. 17



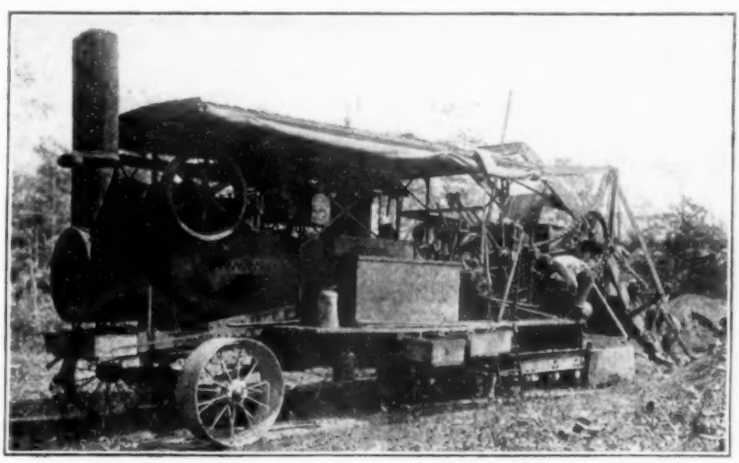
The Army's Foreign Stock of Machinery

By JOHN B. WOODS
Formerly Captain of Engineers, Forestry Division, A. E. F.

American machinery valued at millions of dollars is now in France and Belgium, having been brought there for the use of our engineers. What is to become of it? In this article Captain Woods tells us some of the possibilities of disposing of this material when it is no longer needed by our army.

NOW that the fighting is ended and the tide of American troops is ebbing back toward the United States, the question arises as to what is to be done with the vast stores of foreign-service equipment that we have in France. There is an astounding quantity of our machinery over there; one has only to travel from any French city to any other to be impressed by the fact that our organization extends throughout that country and depends for efficiency upon machinery.

Let us begin at the base ports; there are lighters, motor craft and dredges, gantry cranes, hoisting engines, yard locomotives, machine shops and what not, to improve the ports and to handle the routine business of war shipments. Then there are the steam-railway and motor-truck lines of communication to the depot areas behind the front. The strictly combatant installations, such as repair shops, where they work on everything from top-sergeants' whistles to railway naval guns, within sound of the artillery rumble, and the depot organizations where stores are reconsigned, are all built up around the efficiency of American machinery. Back in the peaceful parts of France there are hundreds of tributary industrial plants furnishing needed material which can be obtained from the country roundabout; crushed rock for railroad ballast, timber and lumber for ties and buildings of all sorts, and other products of the soil. If the war had gone on another year, we probably would have installed agricultural machinery for our own convalescent wounded to make use of in the hospital areas, as European doctors had reached the conclusion that such work is by far the best for men who need something for occupation while being patched up for the front.

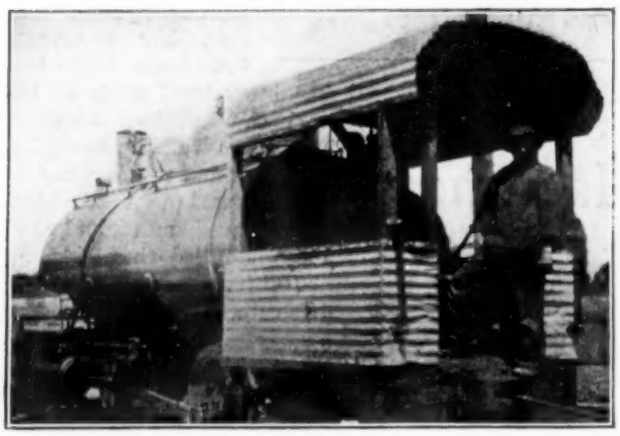


MANY OF THESE EXCAVATORS WERE USED FOR DIGGING INNER LINE OF TRENCHES

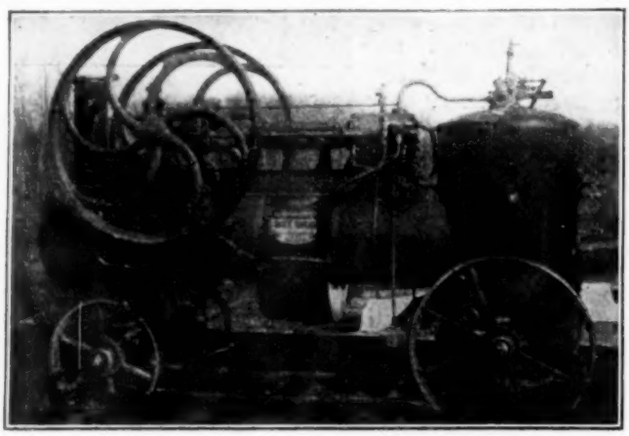
Of course the war was won by machinery, and we may pride ourselves that American factories built a goodly portion of this equipment from the very beginning, culminating fortunately in an overwhelming preponderance of the most-needed types in the hands of our own armies. Germany got the start of the whole world because she had not only more well-trained fighting men than her opponents but more high-class machinery lined up to do the work she had to have done. The others stumbled along improvising and making men to do the part that machines should have handled, and when supplies failed they held the line with nerves and blood. But when it came time to turn about and make the final dash, they went through because the machines were working both at home and in the field. The never-ending line of steaming ships, the plentiful supply of ammunition, and the new naval guns that threw their shells more than 30,000 yd. to break the Longuyon-Mezieres railway behind the Germans, all testified to the efficiency of our machinery, both in their construction and in their operation. France had her mobilization plans quite well conceived, but the first dash through Belgium robbed her of her finest industrial region, and factories that never turned a wheel for France worked almost until the last day for the enemy.

Many fortunes were made from the machinery scrap-heaps of France. Naturally everything that could be renovated and made to function was seized upon. Lathes and machine tools of all sorts were at a premium long before the American Army came into the war, and new equipment was unbelievably high in price. The shell makers bought lathes and the like, paying the market price but profiting by a yearly government concession so long as they devoted their plants to war work. Power was probably the most sought-after item in all the list. There is a man at Nantes, an Englishman, who has been in the second-hand machinery trade for 15 years. He is acquainted with every piece of power plant in northern France, and during the war has ac-

cumulated a vast fortune by virtue of this knowledge. The market price for combination boiler-engine plants, such as we term portable outfits in this country, was 1000 francs per horsepower. This price was not for new stuff but anything in working order, if the boiler would pass inspection. For a small rig of 15 hp. this meant $2700 or thereabouts. Electrical equipment was another high item. French towns do not enjoy electric lights as do so many of our small places, and therefore there was very little spare stock of generators. When factories went upon day and night schedules to meet the needs of war, there was a rush for lighting plants, and the available stock disappeared. One could mention



AMERICAN DINKY ENGINE USED ON NARROW-GAGE ROADS IN FRANCE



TYPE OF FRENCH PORTABLE ENGINE USED FOR LIGHT WORK DURING THE WAR

items ad infinitum, all showing that France was in a bad way for machinery of all kinds.

Such was the situation when America went into the war. The shipping crisis being what it was at that time, our army added the weight of its first demands to the scale. The program outlined for us called for power above all, and chiefly in small portable units. So engineer officers were put upon the road to buy engines, and they scoured the country. Some of the stuff they obtained was valuable only from the antiquarian standpoint, but most of it would and did do good work. We needed lighting plants for warehouses and other projects. We needed locomotives and dinky shifting engines. For our repairs we required machine shops, for the French shops were overloaded with war contracts, they lacked laborers, and could help us little or not at all. Although all the available ship space was being used to bring machinery, it was limited, sinkings were heavy, and France and England were obliged to supply many of our early demands. Naturally enough, we paid the price that the others would pay plus enough premium to swing it away from them. So, therefore, the American Army has on hand at this date a large quantity of second-hand European machinery, bought at war prices and undesirable from any operator's standpoint if modern material is available.

In the ports and depots which we improved or established, there is a great deal of up-to-date freight-handling machinery. France was woefully behind the times in the matter of port facilities. At most of the seaports ships were warped alongside the wharves and unloaded either by human hands or with small swinging-boom cranes that operated by double cranks. The principle upon which all their machinery was built in the old day was cheap labor and high-priced power. There were few giant cranes, and these generally were geared so low (to save power) that they were unbelievably slow. But our engineers showed them the way to handle freight, brought the wherewithal to do it, and the French are loud in their assertions that they never will go back to the old methods where the new are available. Having lost a pathetically large percentage of their labor supply in battle, they probably will be obliged to readjust their machinery-building principles. In short, we should be able to dispose of most of our great port installations at a fair price and to the mutual advantage of France and ourselves. As a matter of fact such a solution of the problem has been commonly understood as a foregone conclusion among the men of the army who did not know the plans of those higher up, but wondered about such things because they were interested. The big depots also should be salable, even if they cannot be used where they stand.

The forestry organization of the A. E. F. was organized in 1917 and developed into a giant that produced as much in a month as a score of our biggest home mills. The plants were small-type mills, equipped when possible with over-size power plants, and were worked night and day. Many French engines were installed in certain sections, but were very seldom retained after American engines arrived, because they had not the necessary power. The usual mill was a rope-feed, circular-saw rig, using insert tooth saws, and built for speed at sacrifice of wood. When one reflects upon the fact that 50,000 men were engaged in getting out timber products in France, one can see that this was a big field for our machinery, and fortunately most of the machinery we used was from our own country.

Description of the Equipment

There may be interest in a description of the equipment of one forestry district which was located in the pine forests in southern France. There were four mills that cut from 70,000 to 100,000 ft.-b.m. of lumber daily, also two smaller plants whose combined output was slightly larger than one of the others. Each plant was fed by narrow-gage railroads from the woods, using small steel cars and 18-ton Porter dinky engines, or jacket-boiler locomotives. Each plant was equipped with vertical steam-engine generators for the electric lighting, and good American steam pumps for water supply. There was a big steam skidder working at one camp to help pull in logs, while a motor boat worked

on a lake rafting logs to one mill in addition to the railroads. The district organization took over 25 miles of railroad from the French and operated trains to and from the mainline junction of the Midi. Altogether there was a big plant, and together with several motor trucks and the steam rolling stock, a machine shop was required to take care of all repairs. With that installed the proposition was practically self-sustaining.

When the hostilities ceased, there was no more use for the mills in any part of France except to clean up certain burned areas. Thus, a great additional quantity of machinery was ready for sale. The forestry equipment was mentioned in detail because it was one of the really large groups of equipment installed over there, and constitutes a problem in itself.

Three Chances of Disposition

The same rule applies in other disposal problems as in the forestry-equipment question, namely, that our machinery does not appeal to all Frenchmen. One will desire to buy, while another complains about the expensive saw-kerf cut by the circular saws. Among engines one finds that one man is delighted with our high-pressure and high-speed engines, while another wants compounding and low-speed machines. In short, there is a great deal of patient salesmanship needed to dispose of this stuff properly so that no regrets will ensue. There are three possibilities that appear to offer the best chances of disposing of the A. E. F. machinery. To sell everything in a lump to the government of France, if they will buy, for distribution to industries that need it most; or the stock may be divided regionally and sold to large moneyed interests for storage and later selling; or thirdly, each item can be sold separately to whoever will pay the nearest to what it is worth. The French object to the second measure because they believe the large interests will obtain the material and hold it to make big money, thereby keeping it off the market when the need is greatest. Apparently no definite policy has been adopted as yet, except that all equipment not in use is being boxed for export and shipped to the depots.

Worn to Less Than Half Value

Whatever is done, we cannot hope to sell the machinery at what it cost laid down in France. The foreign second-hand stuff is a doubtful asset now that its usefulness under war condititions is outlived, and it may well be charged up to profit and loss without spending money to box and ship it even to depots. Much of the American machinery is worn to less than half value, and the less time and money wasted upon it the better. In fact unless our used equipment can be sold where it stands, it would be better financially to leave it alone to the thieves that to try to ship it back to America to be thrown upon a dull market. The French are eager to help us in handling this problem, as they want most of what we have left behind us, and an intelligent handling of the problem will save the War Department a great deal of money and help France get back upon her industrial feet. The machines from America have helped to win the war, which is the main consideration, so perhaps we should not worry about their ultimate fate. But it is an interesting question nevertheless, involving the considerations mentioned herein and such others as import duties and ocean freights.

A Machinist's Criticisms of Modern Shop Systems

By J. B. Gray

Several articles have appeared in the *American Machinist* lately about various systems, good, bad and indifferent, but they are all negative criticisms, and I have looked in vain for that constructive element that we so much need just now. System in the machine shop, the office, the drafting room, and in the corner grocery is alike essential and since so many "hammer artists" are about would it not be as well to hear something from the other side?

On page 518, John R. Godfrey describes, figuratively, a "system"—or a total lack of system—that it is difficult to believe has any counterpart in actual practice. The natural effect of such criticism is to bring into contempt, to burlesque, all shop systems, regardless of their merit. Of course, we appreciate the fine humor of the sketch and I daresay many of us enjoy a good laugh at the expense of "Mr. Johnson," et al.; however, isn't there danger when a subject is persistently and adversely criticized, of producing an undesirable psychological effect, of creating an unreasoning antagonism between the office and the shop that can have no result other than to render more difficult the realization of that coöperative policy we are all desirous of obtaining?

Harry Senior Makes a Wild Blow

On page 493, Harry Senior makes a wild blow in the dark and comes pretty near hitting the nail on the head, in so far as enlisting the sympathies of the men is concerned, but is this all that is required to secure maximum production? I say "No"—most emphatically "No!" Mr. Senior sees only effects and does not go into the matter deep enough to locate and analyze causes, nor does he prescribe remedies except in a very vague and indefinite way—too much "I told you so" stuff, which has never cured any ill, industrial or otherwise.

As it happens, I have had considerable experience as a journeyman machinist under the Taylor and various other systems. While it is true that most of these tend to perplex, discourage and even to provoke the opposition on the part of the workmen that Mr. Senior refers to through excessive application of scientific detail, it does not follow that the system as a system is wrong. I am firmly of the opinion that all systems that have received recognition to any extent, even Mr. Godfrey's "pink slip system" are founded upon sound logic, probably being diverted from the path of reason through unwise elaboration and devotion to the abstract on the part of scientists and mathematicians.

Some 10 years ago, it was my fortune to be employed as a plain machinist by the Tabor Manufacturing Co., of Philadelphia, then, and probably now, the headquarters of the Taylor system, where I had an opportunity to study this system in its purity and at close range. I had heard about those stop watches, "white shirted and becollared youths," etc., and was pleasantly surprised to find that both the stop watch and the becollared youth filled very small and very definite places and were obliged to "function" as part of the system and strictly in accordance with one small-typed instruction card.

Under the Taylor system, the nonproductive force in the shop is composed of a foreman and sometimes one assistant, an inspector, a speed, feed and chucking

boss, one or two drawing boys, one or two tool boys, and one or two laborers. The shop paraphernalia consists of a system of individual bulletin boards, and a work or tool table with a sheet-iron box, or pocket, on either side—that is all.

The modus operandi is as follows: You go to your bulletin board, take the top card which is the job card, and going over to the window, have the clerk stamp it "in." Upon returning to your machine, you find that the drawing boy, who, like the tool boy walks the floor constantly, has already been around to your bulletin board, obtained the number of the job you are to start with from your job card, obtained the drawing and instruction card for you, and placed both in the right box or pocket of your work table. The tool boy at the same time has taken the number of your job card and brought everything you will require, tools, bolts, clamps, blocking, etc. Of all such tools as drills, reamers, counterbores and so on, you have two of each so if one should break or in any way be damaged, you have only to throw it on your work table and go ahead with the second tool. Presently the tool boy will pass by, take up the damaged tool and bring you another one in place of it. All tools, clamps, etc., have been placed in a metal tote-box beside your machine and by the time you get back from having your card stamped you are ready to start to work, no questions to ask, nothing to hunt for and everything right at hand.

The first thing you do is to take your drawing and instruction card from the right-hand pocket of your work table, and while reading your instruction card, place the drawing in the left-hand pocket of your work table so that the drawing boy can bring you the drawing for the second job as per your bulletin board while you are working on the first job; the tool boy will also bring you the tools for the next job and place them beside the work table out of your way. Since this is your first job of the day, Rule 1 on your instruction card will read "oil machine" and time and bonus will be stated. On the other hand, if it is the second or a later job, the first rule will be "clean machine" and the rest of the card goes on to tell about setting up the job; where to set up (base or table if a radial drilling-machine job), what clamps and bolts to use, what speed and feed is required, etc.

Two Exceedingly Good Points

So far this system has two exceedingly good points: First, it relieves the foreman of an enormous amount of detail and permits him to develop ideas, see to the upkeep of the machines, attend to requisitions for material, tools, etc., and other necessary and important work; secondly, it relieves the machinist of those long weary hunts for bolts, clamps and packing; it relieves him of those sloppy, tiresome jobs at the grinding wheel; and it relieves him of those pleasant (?) little constitutionals in search of the drawing.

But Mr. Taylor and his engineers made a mistake when they tried to change the name of every tool, clamp and bolt in the shop; when a common U, or horseshoe clamp becomes a "CCF" clamp, the machinist feels that he is entitled to an explanation. Though a man may be ever so capable and have years of experience, he will be absolutely lost when he starts in a Taylor system shop. It makes you remember vividly the first day of your apprenticeship; other machinists tell me that is the way they feel about it too. No matter what you ask for, you haven't got the name right, according to the system, and it is this highly scientific development that causes the trouble in the shop. Trying to carry the job along and learn the new name of everything at the same time is what "gets your goat."

It seems to me that the Taylor system either should be greatly modified or an elaborate instruction book should be issued to men explaining the operation of the system as well as illustrating and giving the new names of standard shop equipment.

Using the Stop Watch

The stop watch is used when setting the time on a new job and sometimes in re-setting the time on an old one that through improved equipment or because of a better way of chucking or setting up really ought to be re-timed as a mere matter of business.

The "speed, feed and chucking boss" is not the driving, fuming, swearing individual that his title would indicate; he carries a typed sheet giving the various speeds and feeds and if, through faulty material or for any other reason, the feed or speed must be changed, he merely notes it on your card and the speed or feed or both are changed accordingly.

Mr. Senior to the contrary notwithstanding, what we need is not more science, but more hard horse sense.

Suggestions in Welding Cutting Tools

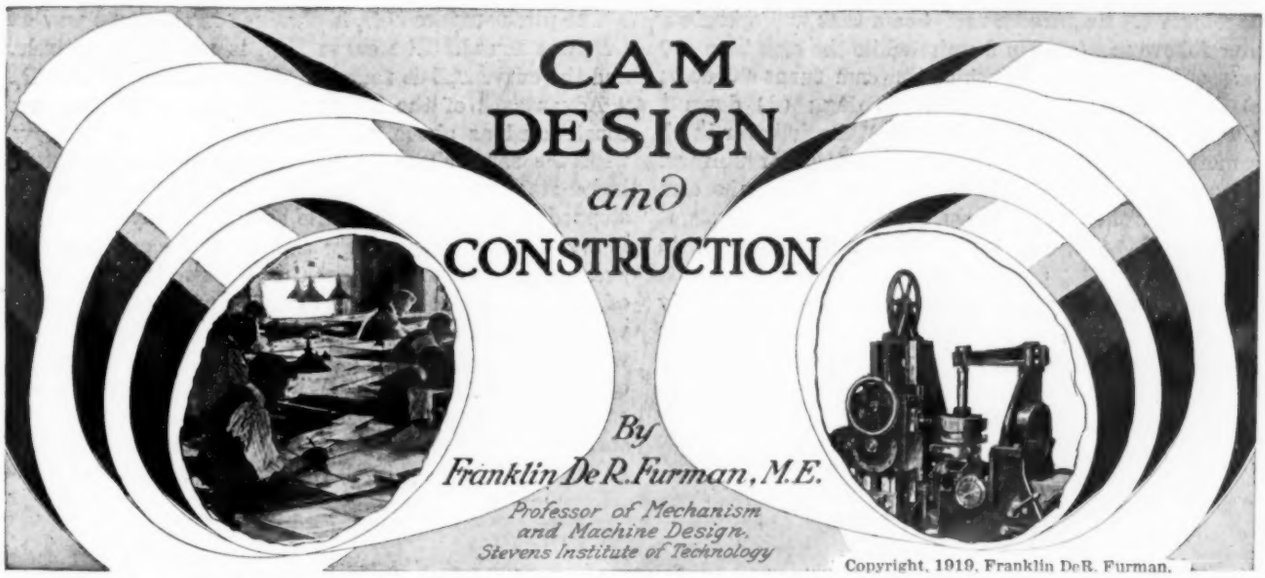
By C. A. Hart

It has been discovered in connection with welding experiments, that it is practicable to weld high-speed tool-steel bits to common cold-rolled steel shanks for lathe and planer tools, drill, reamers, etc., with very satisfactory results. Electric welding high-carbon to low-carbon steel is not a difficult operation, although a little care should be exercised as a slightly different condition exists than where materials of the same analysis are employed.

Experiments have demonstrated that best results are obtained if the thickness of the tool steel is from $\frac{1}{4}$ to $\frac{1}{2}$ the total thickness of tool at the weld. Where two pieces of the same kind of steel are spot welded together they heat evenly, but care must be taken in welding high-speed steel to common steel, the former heats more quickly owing to its offering greater resistance to electric current. The high-speed steel should be thinner in order to generate greater heat at the junction of the pieces. As the copper points used in making these welds are subject to very extreme heat and pressure, they will last longer and do better work if cooled by a stream of water passing through them while in use. When both metals have reached a welding heat, the current is cut off and pressure applied forcing them together. It is not necessary to use any flux in welding but is sometimes advisable to apply a solution of borax water which has a tendency to improve the weld.

If it is desired to temper the tool at the same time it is being welded, it should be plunged while white hot into a bath of good hardening oil. When welding a large toolbit to a shank, it is advisable to corrugate the welding seats in a perpendicular direction and keep them free from oil, dirt or rust.

After the butt weld has been made, the stock must immediately be heat-treated or annealed, in order to keep the high-speed steel from checking or breaking.



III. Empirical and Technical Methods

The current installment gives a comparison of results obtained by empirical and technical methods in cam design. Two different cases of single-step radial cams are solved for definite size and pressure angle. The importance of the pitch line and pitch circle in cam work is illustrated by a discussion of the relation existing between pressure angle and cam size. The proper limit for the follower-roller radius is shown to depend on the pitch surface of the cam and to depend also on whether the cam is single or double acting.

PROBLEM 1. Required a radial cam that will operate a V-edge follower: (a) Up 3 units while the cam turns 90 deg.; (b) down 2 units while the cam turns 60 deg.; (c) dwell while the cam turns 120 deg.; (d) down 1 unit while the cam turns 90 deg.

Applying the simplest process for laying out cams it is only necessary in starting to assume a minimum radius *CD*, Fig. 27, for the cam and then lay off the given or total distance of 3 units as at *DB*. The assigned angle of 90 deg. is next laid off as at DCD_1 and the point D_1 marked so as to be 3 units further out than *D*. Any desired curve is then drawn through the points *D* and D_1 and part of the cam layout is completed. The same operations are repeated for obtaining the points D_2 and D_3 and the entire cam is finished.

If the follower had roller instead of V-edge contact a minimum radius *CD*, Fig. 28, would be assumed as in the previous case, and *D* would be taken as the center of the roller. The closed curve $D\ D_4\ D_1\ \ldots$ would be obtained as before and another closed curve $EE_1\ \ldots$ would be drawn parallel to it at a distance equal to the assumed radius of the roller. The latter closed curve would be the actual outline of the cam.

The closed curve $EE_1\ \ldots$ would be known as the working surface and the curve $DD_1\ \ldots$ as the pitch surface of the cam. In Fig. 27 the pitch and working surfaces coincide because the follower has a V-edge.

Cams are sometimes designed with no more labor than that entailed in the previous preliminary problem, and it may be added that where one has had a sufficient

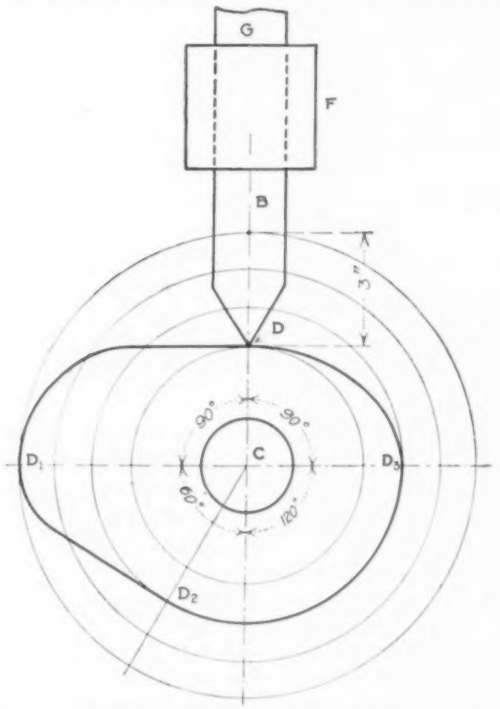


FIG. 27. EMPIRICAL DESIGN OF CAM FOR DATA IN PROBLEM 1, V-EDGE FOLLOWER

experience good practical results may be obtained by following only this simple method.

The method of cam construction described above, however, does not enable the cam builder or designer to hold in control the velocity or acceleration of the follower rod *DG* as it moves up its 3 units; nor does it enable him to know the variable and maximum side pressures which exist between the follower rod and the bearing or guide *F*, Fig. 28, as the rod moves up. In order that these things may be known this preliminary problem will now be redrawn with additional specifications.

Problem 2. Required a radial cam that will operate a roller follower: (a) Up 3 units while the cam turns 90 deg.; (b) down 2 units while the cam turns 60 deg.; (c) dwell while the cam turns 120 deg.; (d) down 1 unit while the cam turns 90 deg.; (e) the follower in all its motions shall have uniform acceleration or uniform retardation; (f) the angle of side pressure of the cam against the follower roller shall not exceed 40 deg.

Items (a), (b), (c) and (d) are the same as in Problem 1.

Inasmuch as this problem is given at this place simply to show that velocity and acceleration and side pressure can always be controlled with very little additional labor beyond that necessary for the simple layout shown in

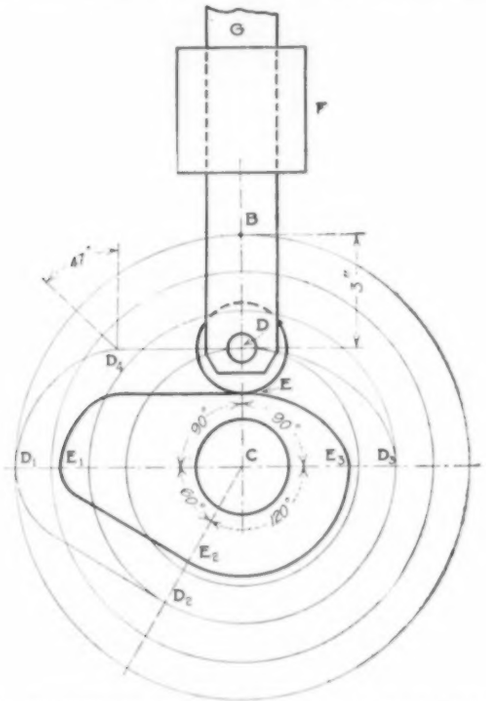


FIG. 28. EMPIRICAL DESIGN OF CAM FOR DATA IN PROBLEM 1, ROLLER FOLLOWER

Fig. 28, the full explanations of the formula and figures used will not be given here. They will be taken up in their proper order in subsequent paragraphs. For this problem the only necessary computation is:

$$r = 57.3\frac{hf}{b} = 57.3\frac{3 \times 2.38}{90} = 4.55 =$$

radius of pitch circle $= CH$, Fig. 29

In the above formula f is the cam factor required for the data specified by c in the problem, h is the greatest assigned follower motion, and b is the number of degrees alloted for this motion. Lay off CH in Fig. 29 and then lay off the follower motion of 3 units equally distributed on each side of H, as at HB and HD. Divide DH into nine equal parts and take the first, fourth and ninth parts; do likewise with BH. Divide the 90-deg. angle BCD_3 into six equal parts by radial lines, as shown, and swing each of the six division points between D and B around until they meet successively the six radial lines. A curve through the intersecting points will be the pitch surface of the cam, as shown by the dash-and-dot curve DH_1D_3. . . The working surface will be EE_3, . . . which is found as described in connection with Problem 1.

The pitch surface D_1D_2 is obtained in the same way as DD_1 was found. The curve D_2D_3 is an arc of a circle, and the curve D_3D is found in the same manner as DD_1.

Advantages of the Technical Design—With the cam constructed as above, the follower will start to move with the same characteristic motion as does a falling body starting from rest, and the follower will be stopped with the same gentle motion in reverse order. It will be definitely known also that the greatest side pressure of the cam against the follower is at an angle of 40 deg., as specified, and that this pressure will occur when H_1 of the pitch surface of the cam is at H, or when the roller is in contact with the point H, of the working surface. Where the cam form is assumed, as in Fig. 28, nothing is known positively of the starting and stopping velocities of the follower. Further, as may be found by trial, the maximum angle of pressure of the cam against the rod runs up to 47 deg. in Fig. 28, as shown at D_1. The minimum radius of the cam in Fig. 28 was taken equal to that in Fig. 29 for comparison.

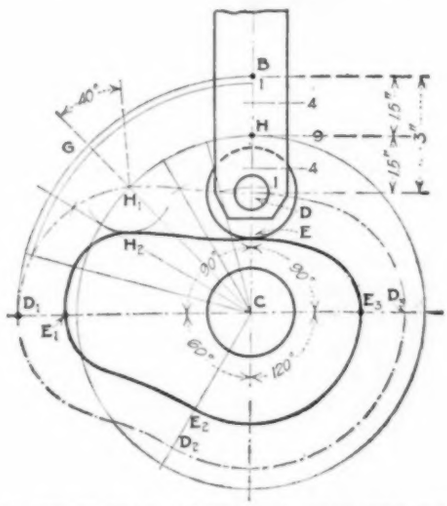


FIG. 29. TECHNICAL DESIGN OF CAM FOR DATA IN PROBLEM 2, DRAWN TO SAME SCALE AS FIG. 28

The two previous problems have been given as brief exercises without going into all the detail necessary to a full understanding, in order to give an idea of the method of producing cams on a scientific basis. In the problems which will follow, the several steps in building cams of various types will be explained. In many of the problems the same data will be used so that comparisons of different forms of cams which produce the same results may be made.

Single-Step Radial Cam, Pressure Angle Equal on Both Strokes

Problem 3. Required a single-step radial cam in which the center of the follower roller moves in a radial line, the maximum pressure angle to be 30 deg. and the follower to: (a) Move up 3 units in 90 deg. with uniform acceleration and retardation; (b) move down 3 units in 90 deg. with uniform acceleration and retardation; (c) rest for 180 deg.

The first step in the solution is to determine the total length of the cam chart for a parabola chart curve and for a 30-deg. maximum pressure angle. From the table of factors in the previous installment, repeated here, the

factor for this case is found to be 3.46. Since the travel of the follower is 3 units in ¼ revolution the total length of chart will be $3 \times 3.46 \times 4 = 41.52$, which therefore is

TABLE OF CAM FACTORS

Name of Base Curve	Maximum Pressure Angle and Values of f				
	20°	30°	40°	50°	60°
Straight line	2.75	1.73	1.19	0.84	0.58
Straight-line combination *	3.10	2.27	1.92	1.77	1.73
Crank curve	4.32	2.72	1.87	1.32	0.91
Parabola	5.50	3.46	2.38	1.68	1.15
Elliptical curve †	6.25	3.95	2.75	1.95	1.35

* For case where easing off radius equals follower's motion.
† For case where ratio of horizontal to vertical axes of ellipse is 7 to 4.

the length of the chart AA' in Fig. 30. This length represents the 360 deg. of the cam. Lay off AW equal to 90 deg., according to item (a) in the data. Construct the parabolic curve AEC as directed in article II. Completing the entire chart the base curve is found to be $ACMNA'$. The next step is to find the radius of the pitch circle. The circumference of this circle is equal to the length of the pitch line DD'. Its radius is therefore equal to $\frac{41.52}{2\pi} = 6.61$, and this value is laid off at OD, Fig. 31, and the pitch circle $DFXT$ drawn. The quadrant DF is divided into the same number of parts as DF in Fig. 30. The vertical construction lines HH_1, II_1, JJ_1 . . . in Fig. 30 now become the radial lines correspondingly lettered in Fig. 31, and the pitch surface is drawn through the points $AH_1I_1J_1$ . . . . The positions of maximum pressure are shown at E and Q; at all other points it will be less. The working surface $BGRP$ is found by assuming a radius AB for the roller, and by striking a series of arcs as shown at H_2 I_2 J_2 . . . with the points H_1 I_1 J_1 . . . as centers, and then drawing the working curve tangent to these arcs. With the same specifications for the up and down motions of the follower, as given by items (a) and (b) in the data, this type of cam will be symmetrical about the line CO in Fig. 31.

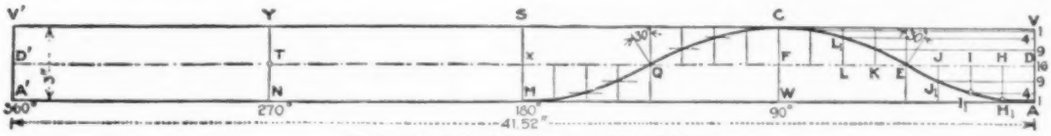


FIG. 30. PROBLEM 3, CAM CHART

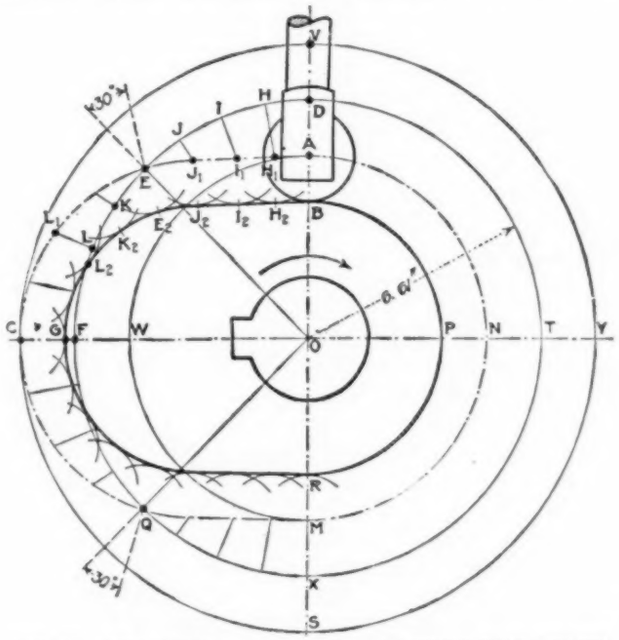


FIG. 31. PROBLEM 3, CAM LAID OUT FROM CAM CHART

Omission of Cam Chart—When the relation between pressure angle, chart base and pitch lines, and cam pitch and surface lines is understood and fixed in mind the actual drawing of the chart for the graphical construction of simple cams and particularly of single-step cams may be omitted with full confidence when the elementary base curves are used. For example, the problem in the previous paragraph is shown completely worked out in Fig. 32 without any reference whatever to the chart of Fig. 30. The radius OD of the pitch circle, Fig. 32, is obtained directly from the formula, $r = 57.3\,\frac{hf}{b}$ given in Article II. Substituting the data as given in the previous paragraph $r = 57.3\,\frac{3 \times 3.46}{90} = 6.61$ and is laid off at DO. The assigned motion of the follower is laid off symmetrically on both sides of the pitch point D, as at AV, and the distances AD and VD are divided into the desired number of unequal parts, as at 1, 4, 9, 16. The quadrant DF is divided into the same number of equal parts as at H, I, J, . . . and indefinite radial construction lines drawn through the points. Circular construction arcs are next drawn through points 1, 4, 9 . . . until they intersect the radial lines, thus obtaining points H_1 I_1 J_1 . . . on the cam pitch surface. In general a neater construction is obtained by omitting the full length of the construction arcs, as from V to C . . . and simply drawing short portions of the arc at the intersecting radial lines as shown in the lower left-hand quadrant between C and M.

Problem 4. Required a single-step radial cam in which the center of the follower moves in a radial line, the maximum pressure angle not to exceed 30 deg. on the outstroke nor 50 deg. on the return stroke and the follower to move: (a) Out 2 units in $\frac{5}{16}$ revolution on the crank curve; (b) in 2 units in $\frac{3}{16}$ revolution on the crank curve; (c) at rest for ½ revolution.

The diameter of pitch circle of the cam that will be necessary to fulfill the requirements on the outstroke will be:

$$d_a = \frac{2 \times 2.72 \times 16}{3.14 \times 5} = 5.54 \textit{ units}$$

from formula in Article II, or

$$r = 0.159\,\frac{2 \times 2.72 \times 16}{5} = 2.77$$

and the diameter of pitch circle required for the instroke will be

$$d_b = \frac{2 \times 1.32 \times 16}{3.14 \times 3} = 4.48 \textit{ units}$$

Inasmuch as there can be only one pitch circle for a cam the largest one resulting from the several specifications must be used. In this problem then the diameter SD of the pitch circle in Fig. 33 equals 5.54 units. The

follower's motion of two units is laid out at AV and the pitch surface $AECMN$ constructed. The working surface of the cam BKG, etc., is then drawn. Since a larger diameter of pitch circle had to be used for the return stroke than the requirements called for it follows that the pressure angle will not reach 50 deg. on

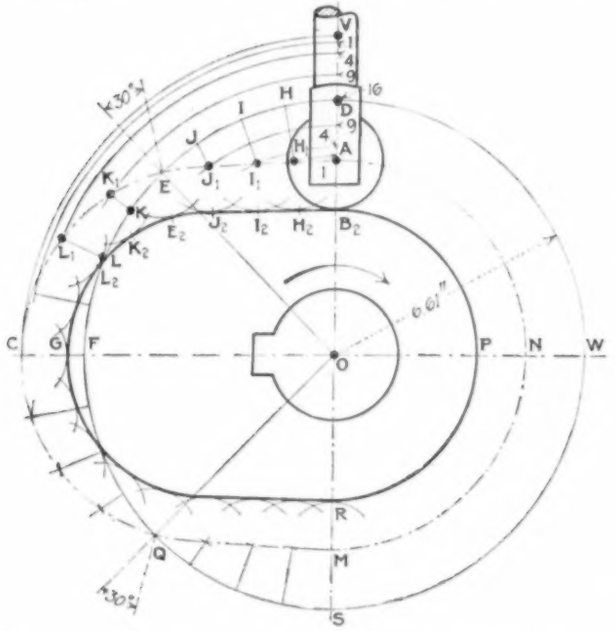


FIG. 32. PROBLEM 3, CAM LAID OUT INDEPENDENTLY OF CAM CHART

that stroke, and it may be of some interest to determine what the maximum pressure angle on the return stroke will be. Substituting the diameter used, 5.54, in the formula $d = \frac{hf}{\pi e}$ and solving for f, f is found to be equal to 1.63. From the chart in Fig. 21, Article II, it is shown that a factor of 1.63 for the crank curve corresponds to a maximum pressure angle of nearly 44 deg., and this angle may be drawn in its proper position at Q in Fig. 33.

Pressure Angle Increases as Pitch Size of Cam Decreases

This is illustrated in Fig. 34, where the large pitch cam represented by D_1 D_2 . . . gives exactly the same motion to a follower as the small pitch cam d_1 d_2 . . . It will be noted that the pressure angle for the large cam at the start is HDG, while for the small cam it is increased to hdg. Likewise the maximum pressure angle for the large cam when the follower is near the end of its stroke is b_1 while for the small cam the maximum pressure angle is b, which is larger than b_1. From these observations it may be said in general that the larger the pitch surface of the cam the smaller will be the pressure angle. The size of the roller has no effect whatever on the pressure angle. Two cams of the same pitch size may be of totally different actual sizes for the same work, one cam having a large roller and the other a small roller. Therefore it is important to remember that in general the pressure angle may be regulated by changing the size of the pitch surface only and not the working surface.

The circumference of the pitch circle of the cam, it will be recalled, is equal to the length of the pitch line on the chart. It will also be remembered that the pitch line may be at various heights on the chart, depending on the nature of the base curve. It is now important to consider:

First, that the pressure angle at the pitch circle on the cam must be the same as the pressure angle at the pitch line on the chart.

Second, that the pressure angle at any point on the pitch surface of the cam outside of the pitch circle will be less than the pressure angle of the corresponding point on the base curve of the cam chart.

Third, that the pressure angle at any point on the pitch surface of the cam inside of the pitch circle will be greater than the pressure angle of the corresponding point on the base curve of the cam chart.

These statements, which are theoretically true for all cases, except the crank curve, are demonstrated in the following paragraph. For the crank curve the statements are true within a fraction of a degree for any ordinary case.

Cam Considered as a Bent Chart—Consider that the cam itself is the cam chart bent in its own plane so that

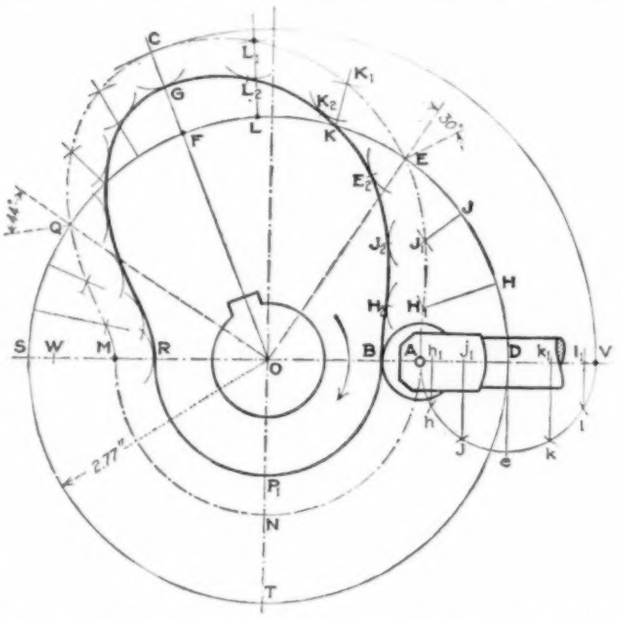


FIG. 33. PROBLEM 4, MAXIMUM PRESSURE ANGLE DIFFERENT ON THE TWO STROKES

the pitch line becomes the pitch circle without being either stretched or compressed. Then the line DD', Fig. 30, becomes the circle $DFXT$, Fig. 31; the line VV' is stretched to become the circle $VCSY$, and the straight line AMA' is compressed to become the circle AMA. This means in a general way that the rectangle $DVV'D'$, Fig. 30, is so distorted that if a straight diagonal line had been drawn from D to V' it would have an increased length and a decreasing slant after the bending had taken place. With a decreasing slant of the pitch surface the pressure angle will decrease. Likewise a diagonal drawn from D' to A in the original rectangular chart would be decreased in length and would have an increasing slant in the cam and the pressure angle would be increasing toward A. This is illustrated in detail in Figs. 35 and 36.

Base Line Angles, Before and After Bending—The

pressure angle of 30 deg. at *E* in Fig. 35 is reduced to 23 deg. in Fig. 36, and the 30 deg. at *D* are increased to 41 deg. Fig. 35 represents a cam chart with a straight base line *DE*, and Fig. 36 is a corresponding cam sector with *DE* as the pitch surface. If

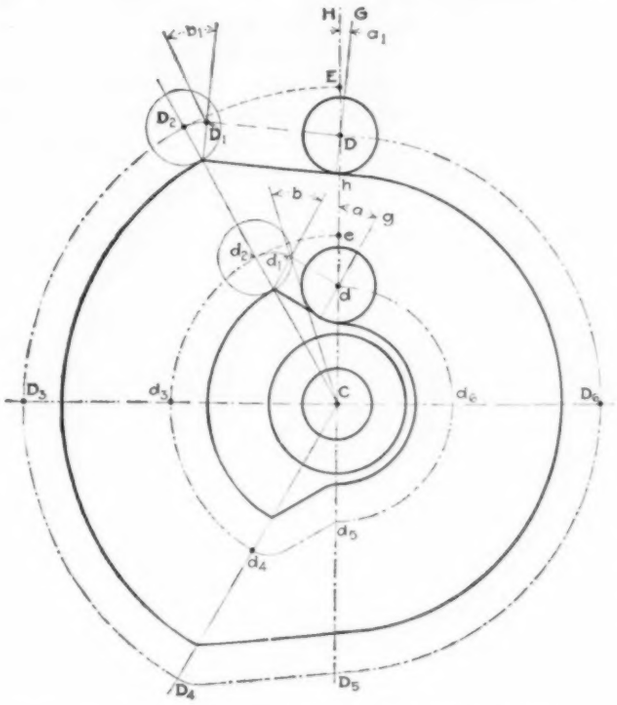


FIG. 34. SHOWING RELATION BETWEEN PRESSURE ANGLE AND SIZE OF PITCH CAM

BC, Fig. 35, is taken as the pitch line, *BC*, Fig. 36, will be part of the pitch circle. The uniform pressure angle of 30 deg. from *A* to *E*, Fig. 35, will grow smaller beyond *A* in Fig. 36 for the reason that the radial components of the tangential triangles remain constant, as illustrated at *LM* and *NP*, while the tangential components grow longer as illustrated at *EL* which is longer than *AN*. These tangential components are equal respectively to the arcs EL_1 and *AY*. The radial components are all equal as shown at L_1M_1, etc. Consequently, the angles grow smaller from the angle *NAP* to *LEM*. Similarly the angles grow larger from *NAP* to *QDR*.

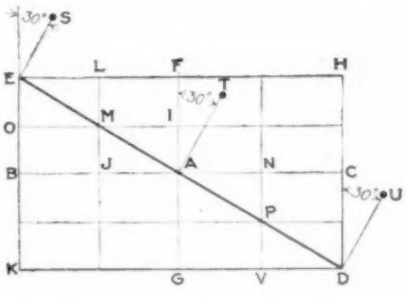


FIG. 35. SECTION OF CAM CHART BEFORE BENDING

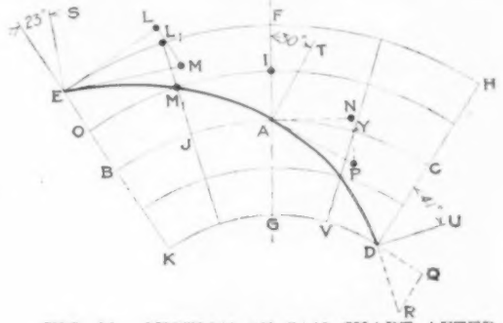


FIG. 36. SECTION OF CAM CHART AFTER BENDING

LIMITING SIZE OF FOLLOWER ROLLER—The radius of the follower roller may be equal to but in general should be less than the shortest radius of curvature of the pitch surface when measured on the working-surface side. If the radius of the roller is not so taken the follower when put in service will not have the motion for which it was designed.

Case I. Radius of roller equal to radius of curvature of pitch cam—In Fig. 37, *ABEFA* is the pitch surface of a cam; *GA* is the radius of curvature at *A* and *AG* is the radius of the roller. In this case both radii are equal and the working surface has a sharp edge at *G*.

Case II. Radius of roller greater than radius of curvature of pitch cam—From *B* to *C*, Fig. 37, the radius of curvature of the pitch surface is *HB*, which is less than the roller radius. In this case the working surface will be undercut at *I* in generating the cam, and if the cam is built the center of the roller will mark the path $B_1J_1C_1$ instead of *BJC*, and the follower will fail to move the desired distance by amount JJ_1.

Special application of Case II. Effect of an angle in the pitch surface outline—This is illustrated at *RFQ* in Fig 37, and is a special application of Case II, in which the radius of curvature of the cam's pitch surface is reduced to zero. Undercutting is here illustrated by considering that a cutter represented by the dash circular arc is moving with its center on the pitch surface arc *EF*. It then cuts the working surface *MS*. As the center of the cutter is moved from *F* toward *A* the part *WS* of the working surface which was previously formed is now cut away, leaving the sharp edge *W* on which the follower roller will turn when the cam is placed in operation. The center of the follower roller will then move in the path *RTQ* instead of *RFQ* and the follower will fall short of the desired motion by the amount *TF*.

Case III. Radius of roller less than radius of curvature of pitch cam—From *D* to *E*, Fig. 37, the radius of curvature of the pitch surface is *KD*, which is greater than the roller radius. In this case, which is the practical one, although close to the limit, a smooth curved working surface is provided for the roller from *L* to *M*.

Radius of roller not affected by radius of curvature on nonworking side—From C_1 to *D*, Fig. 37, the radius of curvature of the pitch surface is less than the radius of the roller, but this short radius is not on the working side of the pitch surface, and therefore the roller will roll on the surface *IL* while its center travels on the pitch curve C_1D.

Rollers for positive-drive cams—When the largest roller for a positive or double-acting cam is being determined the radius of curvature on both sides the pitch-surface curve must be considered and the smallest radius used. For example, in Fig. 37, if *AJETA* were the pitch surface for a double-acting cam *NC* would be the maximum roller radius, whereas *HJ* would be the maximum radius if it were for an external single-acting cam.

Radius of curvature of noncircular arcs—In illustrating the above cases the pitch surface was assumed as being made up of straight lines and arcs of circles in order to show more effectively and more simply the limits of action in each instance. Where the pitch surface contains curves of constantly varying curvature, and they generally do in practice, the shortest radius of

curvature of the pitch surface may be found with all necessary accuracy by trial with the compass, using finally that radius whose circular arc agrees for a small distance with the irregularly curved arc. For example,

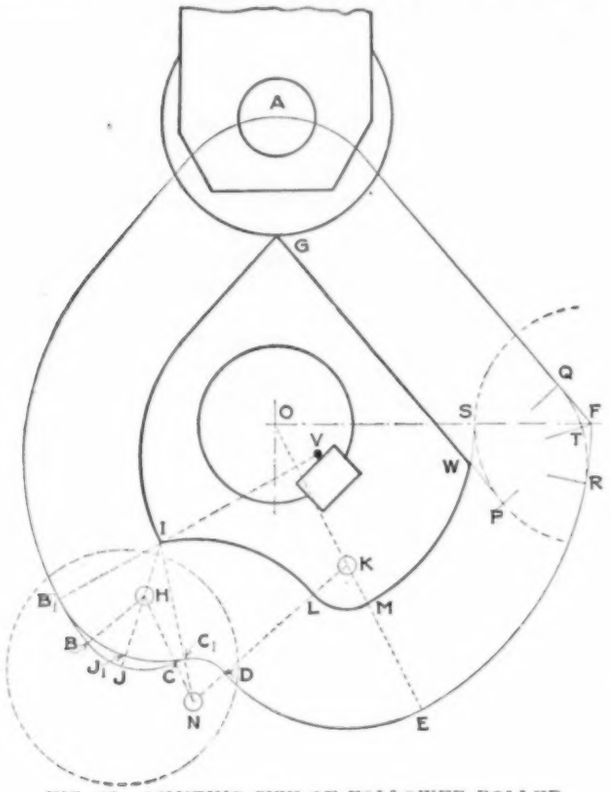


FIG. 37. LIMITING SIZE OF FOLLOWER ROLLER

in Fig. 38, let *GHDJB* be a portion of a pitch surface made up of noncircular arcs. The shortest radius of curvature on both sides is found by trial to be *FH*.

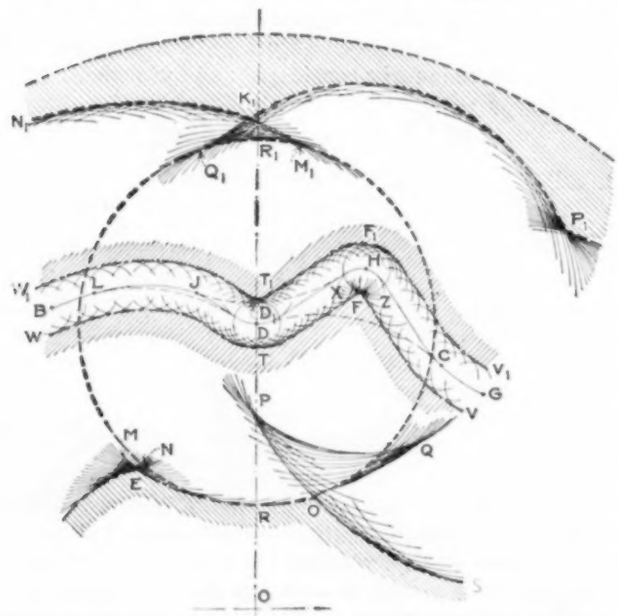


FIG. 38. LIMITING SIZE OF FOLLOWER ROLLER WORKING ON NONCIRCULAR CAM CURVES

The center *F* is marked and the osculatory arc *XHZ* drawn in. Then *HF* is the largest possible radius of roller for a double-acting cam, and with this roller the working surfaces will be *VFTW* and $V_1F_1T_1W_1$.

If a large roller is used with a radius *DR*, for example, the working surfaces of the groove will be *SOE* and $P_1K_1N_1$ and the new pitch surface, after cutting the cam, will be *GCDLB* if the roller is kept always in contact with the inner surface of the groove. If it is kept always in contact with the outer surface of the groove the original pitch surface will be changed to $GCHD_1JB$. In either case the original desired follower motion is not obtained if the roller is too large, and if a positive-drive cam is run with the larger roller the follower's motion will be indeterminate, the center of the roller having any possible position between *CDL* and CHD_1JL.

Checking Out Tools From the Crib

ROBERT M. HAYES

The brass-check system of keeping track of the shop tools which are supplied to workmen from the tool crib is in almost universal use, but it has inherent faults, not the least annoying of which is the occasional loss of a check and the consequent suspicion directed toward the unfortunate individual whose number it bore. A modification of this system which has come under the writer's observation has resulted in the elimination of most of this trouble.

A board having a numbered hook for each employee is hung in the crib, and at the window is kept a stack of cards about 2 in. square, each with a small hole pierced near one corner. When a man wants a tool he writes its name and his number on two of these cards. The keeper then hangs one card on the correspondingly numbered hook and puts the other in place of the tool which he hands to the workman.

When the tool is returned the workman gets back his two checks, which he destroys. Thus the keeper can tell by a glance at the board whether or not a workman has any of the company's tools, and if he has, can easily determine what they are.

The only chance a workman has to beat this system is to sign another man's number to his checks, but the keeper soon gets to know each man by number and such dishonesty becomes impossible.

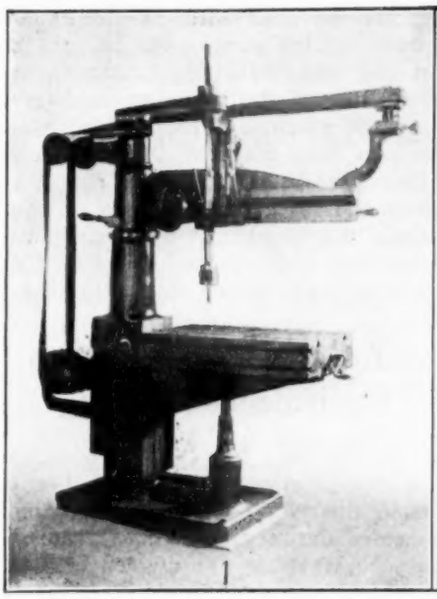
Carbon Paper in the Drafting Room

BY JOHN S. CARPENTER

Carbon paper is usually associated with the click of typewriters and the odor of *eau de cologne*, but if given a trial in the drafting room it will be found to lend itself readily to some details of the work that without it would require more time, and thus it becomes an aid to efficiency.

Sometimes one has a tracing of a machine part that he desires to transfer to a drawing. This can be done very easily by positioning the tracing upon the drawing and then slipping the carbon under it. The lines of the tracing are then gone over with a smooth pointed pencil or other suitable tool, leaving a clear and sharp reproduction upon the drawing.

If small drawings are needed for salesmen or for the shop, they may be made on thin paper under which is a sheet of carbon paper that may be used as a tracing to secure neat white prints on blueprint paper. With a good quality of carbon paper the time necessary for printing is not greatly in excess of that required when using tracing cloth.



GOVERNMENT MACHINERY IN SCHOOL SHOPS

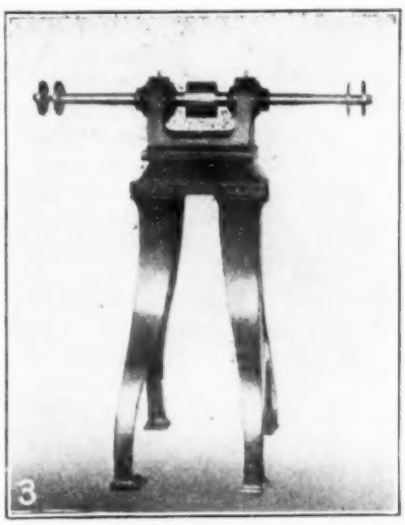
BY R. W. DERBY

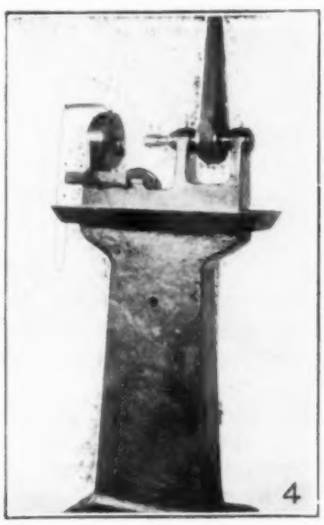
This article presents tangible evidence of the work done in the machine shops of some of our preparatory schools and indicates what might be accomplished in such schools if the bill proposed by Mr. Caldwell in the House of Representatives should pass and make available for use some of the machine tools standing idle in army supply depots and shops.

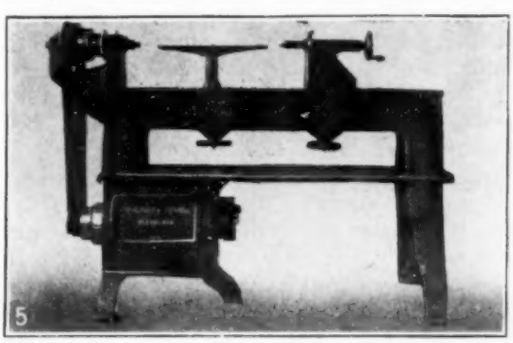
APROPOS of the bill pending before Congress to lend to technical and manual-training schools the surplus of machine tools owned by the Government and of no use to it now that peace is practically assured, it might be well to call attention to some of the work that has been done and the kind of work that is undertaken in these schools.

Many people have the erroneous idea that all school shops are merely playgrounds where pupils may while away an hour or so each day, more for recreation than for profit, and that these machines could be put to a better use than simply serving as toys. It is to correct this idea, so far as possible, and to arouse sentiment in favor of Congress passing the proposed measure that this article is submitted. In the University School, Cleveland, Ohio, which is a college preparatory school embodying manual training as a necessary preparation for a technical course, there is a woodworking shop, a machine shop and a forge shop, in each of which, so far as conditions will permit, practical shop work on a shop basis is undertaken. As it is the machine shop that is of most interest to those concerned in the pending bill, I shall direct attention to the things done there.

The school is equipped with two 14-in. engine lathes of the old type—no taper-turning attachment, no power cross-feed, and the change gears being changed by hand. There is also one 22-in. lathe of the same type, save that it has power cross-feed, a 24-in. planing machine, a 14-in. shaping machine, an 18-in. drilling machine, a sensitive drill and five hand lathes. In addition to these are the following machines which were made in the shops of the school: One 3-ft. American radial drilling, 1 grinding, 1 buffing and 2 centering machines, and three motor-driven lathes. The illustrations will show more clearly than words what has







FIGS. 3 TO 7. PRODUCTS OF THE UNIVERSITY SCHOOL MACHINE SHOP

Fig. 3—Buffing machine. Fig. 4—Centering machine. Fig. 5—Motor-driven machine. Fig. 6—Drawing table and stool. Fig. 7—Lantern at dormitory entrance.

been accomplished. The castings and drawings for the radial drill, Fig. 1, were furnished by the American Tool Works Co., Cincinnati, but all the machining, finishing and fitting was done by boys under 19 years of age.

Machining the Castings Required a Great Amount of Scheming

When the machine equipment of the school is considered it will be realized that machining these castings required a large amount of scheming, and had the base been but $\frac{1}{4}$ in. wider it could not have been planed; the setting and boring of the radial arm in the 22-in. lathe was no small matter. It should also be remembered that while there was a teacher to advise and suggest, the work was all done by the boys and many of the awkward machine operations were engineered entirely by them.

The grinding machine, which in Fig. 2 is shown without guards, was designed and made here, as was also the buffing machine, Fig. 3. Both are equipped with SKF ball bearings and both have been set on

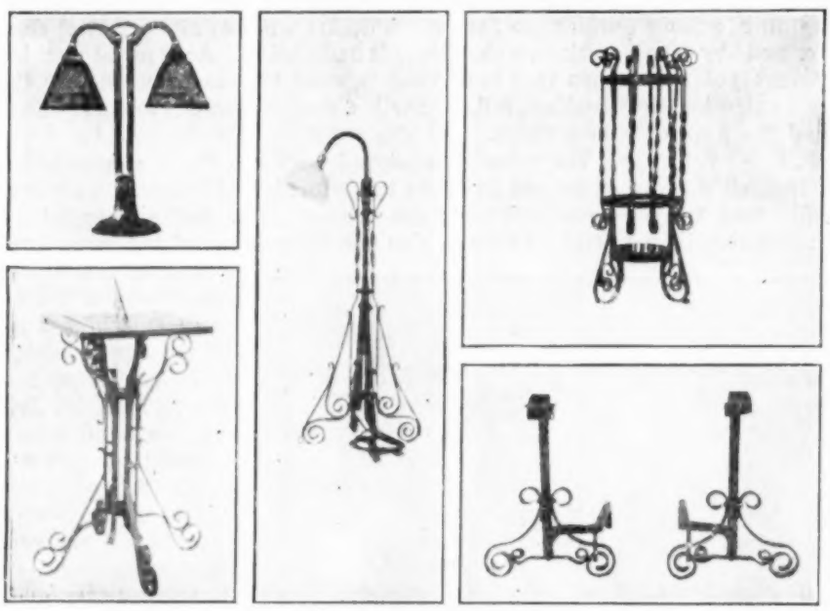


FIG. 8. EXAMPLES OF BRASS AND FORGE WORK

some old machine legs that were on hand. The heads, it will be noticed, are solid, and the spindle caps have grooves turned in them for felt dust washers. While it may look as though the assembling of the head was difficult it was in reality quite simple.

The motor-driven lathe, Fig. 5, is another of our products which we are very proud of. I think the picture will speak for itself. The centering machine, Fig. 4, was the first of these machines to be made in the shops and has been in service for about 15 years.

In addition to the machines mentioned the school has made 30 drawing tables and tools, Fig. 6, a description of which was published on page 131, Vol. 49, of the *American Machinist*, and it is now working on an adjustable school desk.

The bronze lanterns at the entrance to the school and the copper lantern at the entrance to the dormitory, Fig. 7, were designed and made by the boys.

This year the school is repairing and completely rebuilding a 1914 Ford touring car, which was undertaken because of the scarcity of metals for other work, and it has been found to be an excellent and helpful study. The drop light and, sundial show some brass work while the sundial and umbrella stands, andirons and floor lamp give an idea of the forge work, Fig. 8. The school has in its possession pictures of many other things that have been made by the boys in its shops, ranging from brass bookracks to gas and steam engines, but I think the foregoing will serve to show that it is worth while to put some of the idle equipment owned by the Government at the disposal of good schools where the purpose is serious and the results significant.

Easy Method for Calculating Decimal Equivalents

By Harvey Mead

One may with a little practice find the decimal equivalent of any common binary fraction of an inch almost instantly by the use of the method here outlined.

For convenience the fractions are divided into two groups, viz., major and minor. The major fractions are: $\frac{1}{8} = 0.125$; $\frac{1}{4} = 0.250$; $\frac{3}{8} = 0.375$; $\frac{1}{2} = 0.500$; $\frac{5}{8} = 0.625$; $\frac{3}{4} = 0.750$; $\frac{7}{8} = 0.875$. The minor fractions are: $\frac{1}{16} = 0.0625$; $\frac{1}{32} = 0.03125$; $\frac{1}{64} = 0.015625$; $\frac{3}{64} = 0.046875$. To find the decimal equivalent of any fraction take the nearest major fraction and add or subtract the nearest minor fraction. For example, to find the decimal equivalent of $\frac{7}{16}$: The nearest major fraction is $\frac{1}{2}$ or 0.500, and the nearest minor fraction is $\frac{1}{16}$ or 0.0625; subtracting the minor fraction we have as the decimal equivalent, 0.4375. To find the decimal equivalent of $\frac{25}{32}$: The nearest major fraction is $\frac{3}{4}$ or 0.750, the nearest minor fraction is $\frac{1}{32}$ or 0.03125; adding these we get 0.78125. To find the decimal equivalent of $\frac{53}{64}$: The nearest major fraction is $\frac{7}{8}$ or 0.875, the nearest minor fraction is $\frac{3}{64}$ or 0.046875, subtracting we find the decimal equivalent to be 0.828125. From this it will be seen that the most one will have to add or subtract at any time is the equivalent of $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, or $\frac{3}{64}$. Since everyone knows the decimal equivalents of the major fractions it is an easy matter to learn the equivalents of the minor fractions. Four places is all one needs and three in most cases will be sufficient.

[The foregoing method involves memorizing 11 equivalents and, in addition, performing four distinct mental operations every time any one of the remaining 52 is required: viz., determining the nearest "major fraction"; determining the nearest "minor fraction"; ascertaining whether the computation is to be addition or subtraction; and making the calculation. In the days of our youth we were required to memorize these equivalents and repeat them from memory exactly as in our pinafore period we were taught to recite c-a-t cat, d-o-g dog, etc. We still believe that these equivalents should be taught to all students and apprentices. There is no royal road to learning in either the school or the machine shop; the real mechanic must know the a-b-c of his trade.—Editor.

AUTOMOTIVE CONSTRUCTION

The Manufacture of Marine Gas Engines

BY J. V. HUNTER

A demand has recently been made manifest for powerful gas engines of comparatively light weight for marine and other powers. This has enabled one manufacturer to adapt his machines and fixtures to handling heavier work of this class than has been usual in quantity production.

THE manufacture of marine gas engines has been interestingly developed in the shops of the Van Blerck Motor Co., Monroe, Mich., which has specialized in the manufacture of heavy marine gas engines of from 4 to 12 cylinders each. Rather than build such special machine tools as are found in many automobile-engine plants the management has constructed numerous jigs and fixtures to adapt standard machine tools to the rapid production of its work.

Standardization has been carried out in the construction of this engine to as great an extent as possible, the cylinders being all of the same bore and stroke for all sizes of engines. Different engine powers are provided for by varying the number of cylinders. Many parts can thus be made standard for all sizes of engines, the necessary variations being confined to crankshafts, engine bases, etc. The capacity of the shop is gaged to produce a certain number of finished cylinder parts weekly, and this rate of production is maintained regardless of the number of other parts which are required to make up whatever quantity of engines may be under construction.

Special jigs and fixtures have been constructed for machining the gas-engine cylinders that are different from those generally found in this line of work. One of these, shown in Fig. 1, holds the cylinders while the flanges for connecting intake and exhaust manifolds and water circulation are finished on an Ingersoll milling machine. The cylinders are made in pairs, or two cylinders to each casting, and in this view two such pairs are shown in place while a third section is empty. The points *A* are small plugs which fit into drilled holes in the base of the cylinders to align them in the same position that they will occupy on the engine bed and insure that the flange surfaces will be milled correctly. The opening on the side of the cylinder shown in this view is the circulation water outlet, and a cutter on the opposite side of the machine finishes the inlet at the same time.

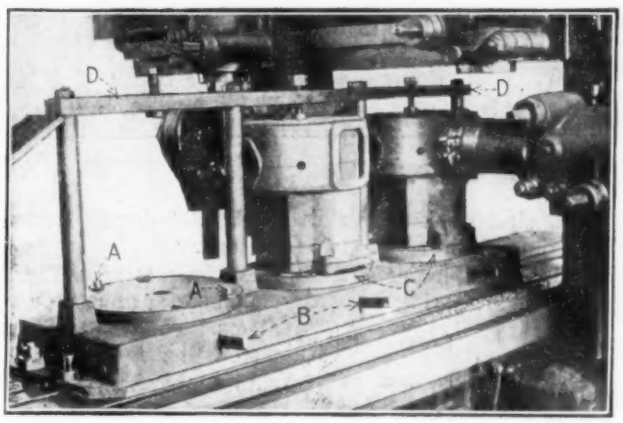
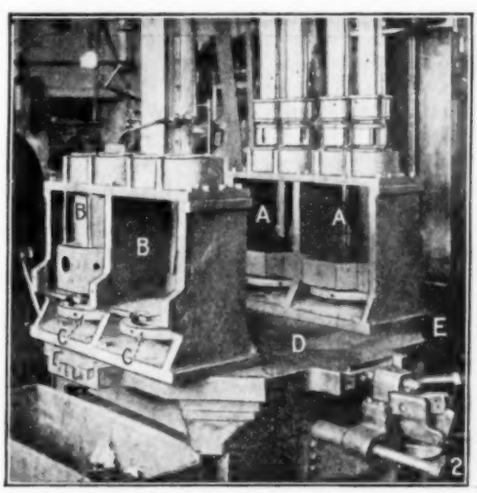
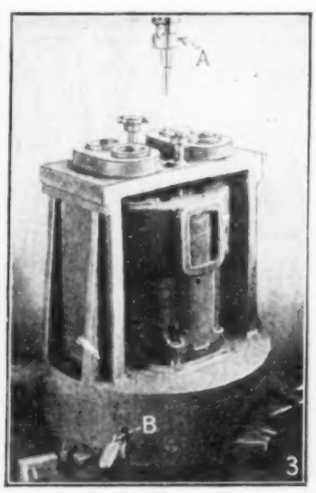


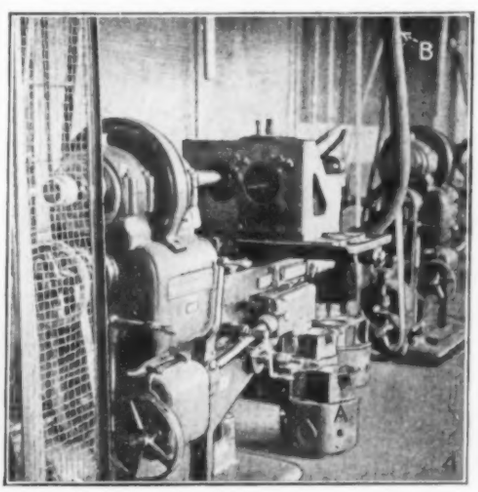
FIG. 1. MILLING SURFACES FOR MANIFOLD AND WATER CONNECTIONS

The levers *B* control the latches which locate the turntables *C* on which the castings are clamped, and when the work in this position is finished the tables and castings are turned 90 deg. to bring the intake and exhaust-manifold connections in position to be operated upon. To insure added rigidity while in the fixture, the cylinders are clamped down by a heavy set-screw and centering device which passes through the top bar *D*.

Fig. 2 shows the fixture and a portion of a special Beaman & Smith boring mill which was built for boring the cylinders. The center distance of each pair of boring spindles, being determined by the corresponding measurement on the cylinders themselves, is necessarily







FIGS. 2 TO 4. OPERATIONS ON CYLINDERS
Fig. 2—Special machine for boring cylinders. Fig. 3—Indexing jig for drilling valve holes.
Fig. 4—Fixture for grinding cylinder bore.

AUTOMOTIVE CONSTRUCTION

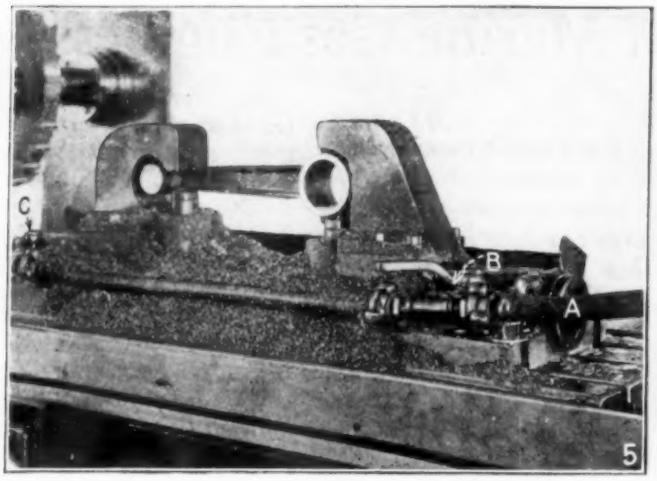


FIG. 5. THE PNEUMATIC HOLDING FIXTURE

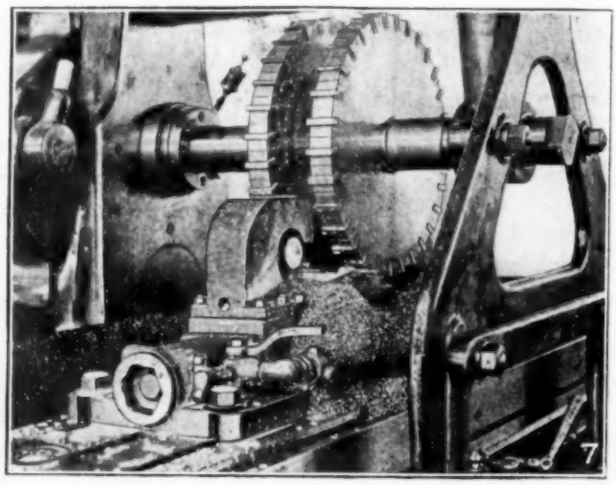


FIG. 7. SHOWING THE SET

small. The four spindles work simultaneously, and while the boring operation is going forward on two cylinder units at *A* two other units are being set in place at *B* in the remaining portion of the boring fixture.

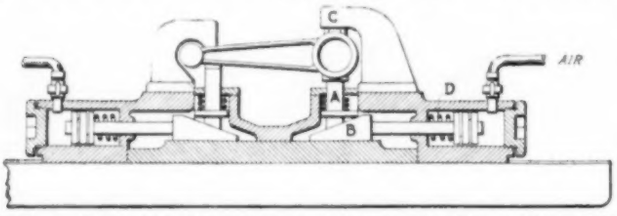


FIG. 6. DETAILS OF THE PNEUMATIC HOLDING FIXTURE

In this view one of the cylinder units is in place in the fixture at *B*, the other three positions being unoccupied. Hardened-steel bushings are provided to guide the boring bars and insure accurate alignment of the bores. The boring tools and reamers used are made by the Kelly Reamer Co., Cleveland, Ohio. The work is clamped by screws and handwheels *C*, which exert pressure on the head of the cylinder to force its previously milled base firmly against the top plate of the fixture. The turntable *D* rotates about a central stud, the indexing levers and stops for locating it being shown at *E*.

An indexing jig, Fig. 3, is used for drilling the valve chambers forming the valve seats and drilling for the stems. The cut does not show the jig in working position. The valve-stem reaming bar *A*, with reamer, is shown above the jig, and bushings in the latter serve to align it by means of a hardened-steel collar on the bar. By tripping the indexing lever *B* the jig may be turned to bring the next hole in line with the boring bar. This movement will not be an equal distance in each case, but the index plate takes care of this according to the spacing of the holes. A Hoefer gang drilling machine was used to replace the jig.

ANOTHER HOLDING FIXTURE

Another special holding fixture is used on a Heald internal grinding machine to hold the cylinder units during the grinding of the cylinder walls. Fig. 4 shows this fixture in place on the machine and one of the cylinder units on the floor at *A*. A flexible suction pipe *B* is connected to an exhaust fan for the purpose of carrying the dust of grinding away from the work. This pipe is suspended from the ceiling, and makes a

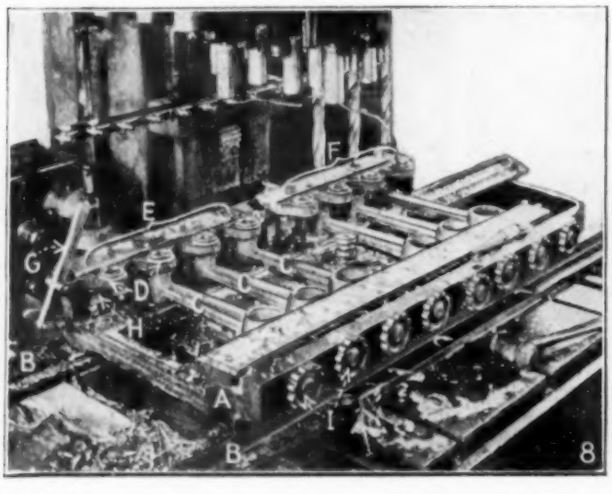


FIG. 8. JIG FOR DRILLING CONNECTING-RODS

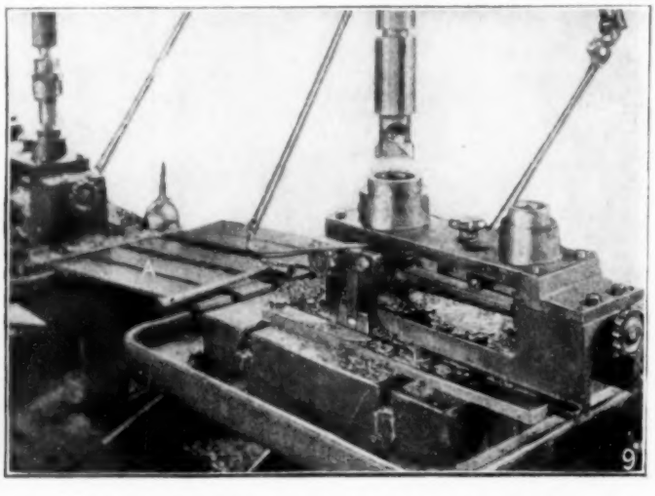


FIG. 9. BORING AND REAMING THE RODS

AUTOMOTIVE CONSTRUCTION

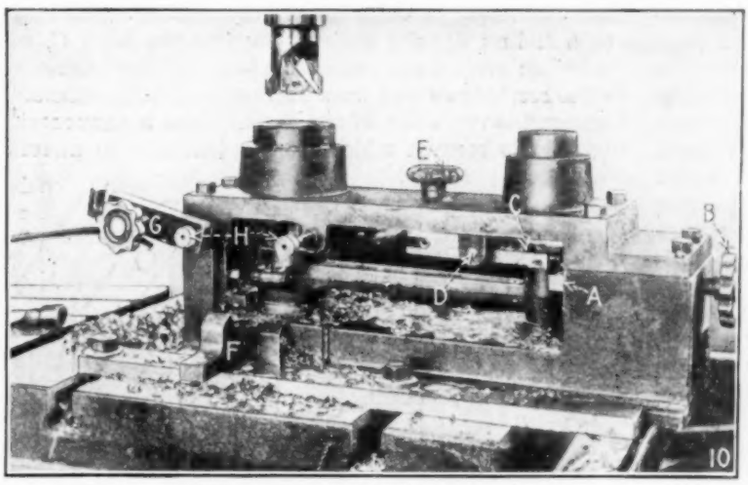


FIG. 10. A COMPENSATING JIG

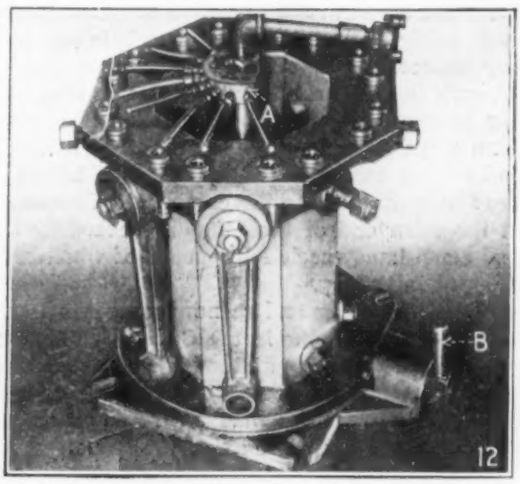


FIG. 12. INDEXING JIG FOR DRILLING

convenient arrangement, as the machine can be easily and conveniently operated without interfering with it.

In machining the connecting-rods it is necessary to guard against possible distortion caused by clamping them in their fixtures and thus throw the bores and finished surfaces out of line. A thorough study was made of the different methods which could be employed for holding them.

The first operation is the straddle-milling of the two parallel faces, and for this work the pneumatic holding fixture shown in Fig. 5 was designed. A cylinder is located at each end of the device to insure independent gripping and eliminate the possibility of leaving one end loose, as could easily occur from variation in the size of the forgings if but one cylinder was used to operate both ends. The air pipe *A* feeds both cylinders through the cocks *B* and *C*. The operation of this device may be better understood from Fig. 6, which shows how the air piston thrusts a wedge beneath the plungers *A*. The hardened tool-steel wedges *B* have a working angle of 20 deg., which exerts a pressure on the plungers, gripping the work firmly between the upper ends of the latter and the overhanging brackets *C*. When the air is released the springs *D* withdraw the wedges and release the work. Another view of this fixture in Fig. 7 shows the air cylinder for the small end of the connecting-rod and the two large inserted tooth mills.

The small ends of the connecting-rods are forged solid and a preliminary drilling operation removes the major portion of the stock before the final boring and reaming operation. A jig, Fig. 8, is provided for this work, which holds four connecting-rods undergoing the drilling operation, while four more are being inserted in the opposite end. The main body *A* of this jig slides on the track *B* so that it may be pushed to the right or left to bring it beneath the drills. As here shown, three connecting-rods *C* are in the jig, while the fourth space is empty.

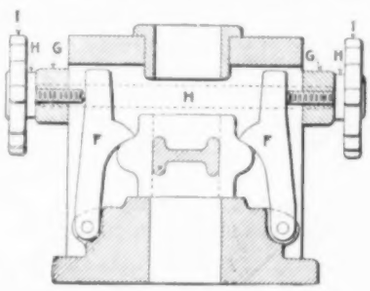


FIG. 11. DETAILS OF THE COMPENSATING JIG

The drill bushings *D* are carried on movable sliding pieces, *E* and *F*, each of which has four bushings, and

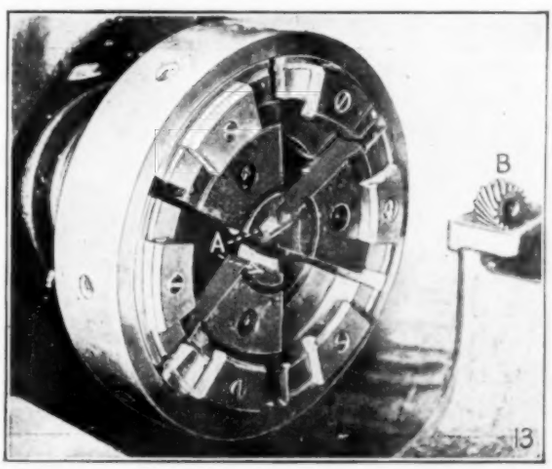


FIG. 13. CHUCK FOR GRIPPING SPIRAL GEARS BY THE BASE OF THE TEETH

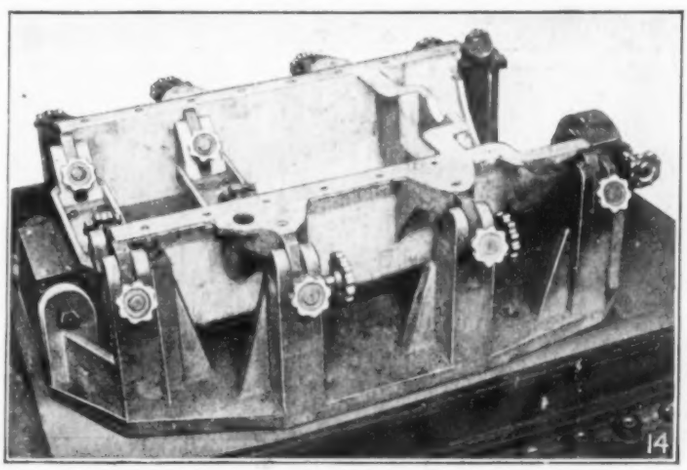


FIG. 14. COMPENSATING FIXTURE FOR HOLDING OIL PANS

AUTOMOTIVE CONSTRUCTION

when one section is in line with the connecting-rods, as at *E*, ready for drilling, the other four are spaced halfway between, permitting the ready removal and insertion of work in that half of the jig that is idle. The bushing holding parts are moved back and forth between fixed stops by means of the hand levers *G*. The small end of the connecting-rods fit into V-blocks *H* which are firmly attached to the casting *A*. Movable V-blocks at the other end of the rods are backed by the screws and small handwheels *I* by means of which the work is clamped in the jig.

The final boring and reaming operations on the connecting-rods are done in the Colburn drilling machines, Fig. 9. The machine at the right bores and reams the large hole, and then the jig is moved across to the other machine. The wooden platform *A* serves as a bridge to assist the workman in making the transfer.

It is very necessary to avoid springing the work when clamping, for reasons before noted, and in Figs. 10 and 11 may be seen in detail the method by which this is accomplished.

The rod is held by endwise pressure of the V-block *A* backed by the screw and handwheel *B*. The small end is prevented from lifting by the forked end of lever *C*, which is fulcrumed at *D*, and its opposite end drawn up by screw and handwheel *E*.

To hold down the large end of the rod the jig is provided with the latches *F*, Figs. 10 and 11, which get a grip on the heavy rib, or lug, which forms a portion of the section of the connecting-rod at this point.

When these latches are raised into the position shown in Fig. 11 the links *G* on either side of the fixture are swung down to a horizontal position, the ends hooking back of the shoulders on stud *H*. Both this stud and its mate pass clear through the jig casting, in which they are a sliding fit, and entirely support the links *G*, so that when pressure is put on the backs of the latches *F* by the handwheels and screws *I* the pressure is balanced between the two sides of the work. Thus a compensating hold is secured which has no tendency to distort

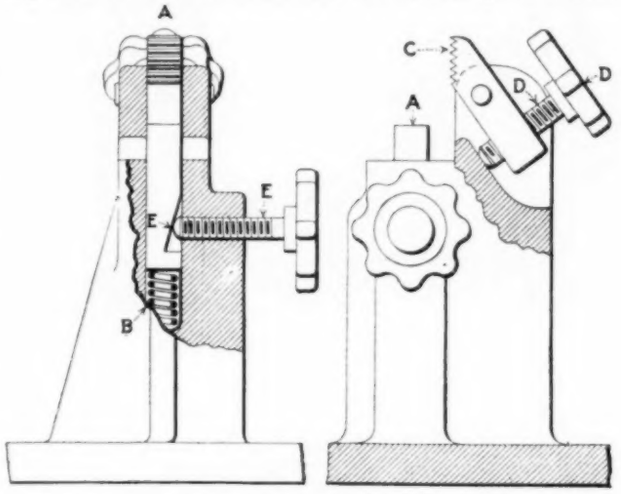
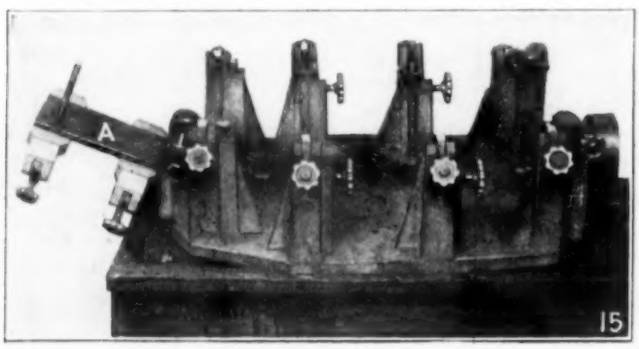
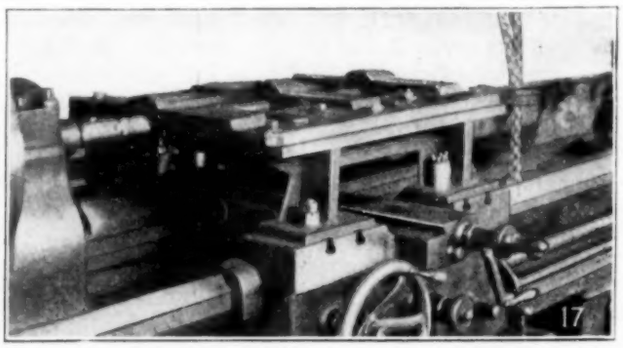


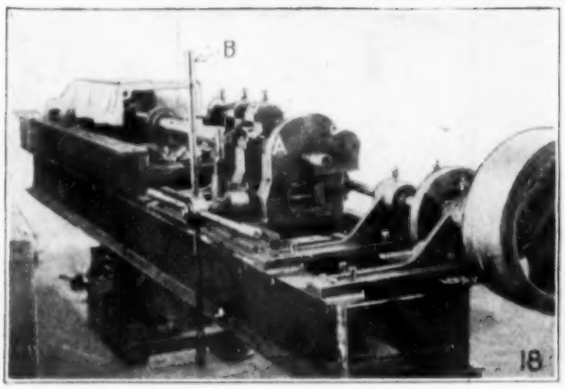
FIG. 16. DETAILS OF THE COMPENSATING FIXTURE FOR HOLDING OIL PANS

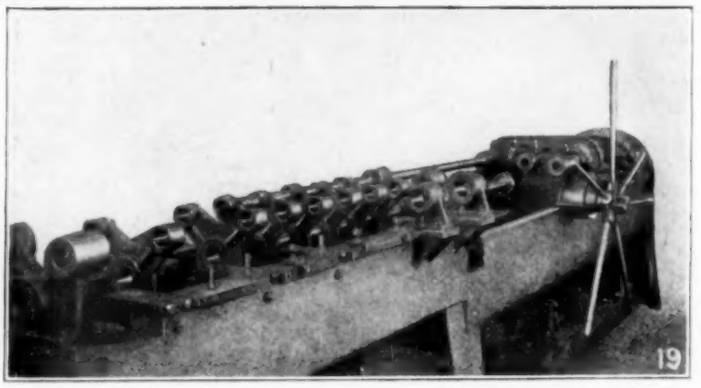
the forging. Kelly drills and reamers are used for removing the stock and several are shown in the illustrations.

Another indexing jig, Fig. 12, is used for drilling the holes for the cap bolts on the rod ends. This jig is so constructed as to permit the operator to unload and reload one-half the number of sections while the drills









FIGS. 15, 17, 18 AND 19. FIXTURES AND SOME OF THE MACHINES USED FOR THE WORK

Fig. 15—Fixture for holding oil pans while milling. Fig. 17—Old lathe improvised for boring bearings in the oil pan. Fig. 18—New machine for the same purpose. Fig. 19—Line reaming machine for camshaft brackets.

AUTOMOTIVE CONSTRUCTION

are working in the opposite half. A multiple drill is used, operating on four rods and cutting eight holes at a time. Distributing pipes for cutting compound serve that half of the jig in which the drills are working, the leads being fastened into the stationary head *A*. When the drilling is finished on the loaded half of the jig the locking pin is withdrawn by means of the handle *B* and the jig turned 180 degrees

All of the spiral gears used for the timing equipment of the gas engines are machined on a Fellows gear-shaping machine, and after hardening it is the practice to grind the bore on a No. 6 Bryant chucking grinding machine. The chuck used for this work, shown in Fig.

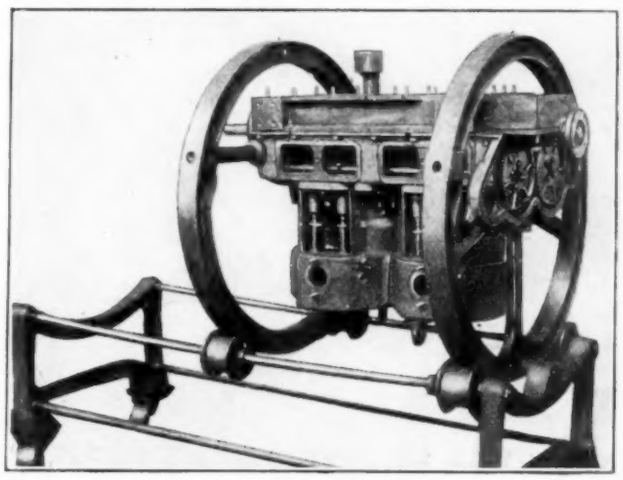


FIG. 20. A CRADLE FOR ERECTING ENGINES

13, is interesting because it grips the gears at the base of the teeth in order to insure perfect alignment and prevent crushing or distorting the tooth shape. The chuck jaws each have a projection *A* corresponding to the shape of a tooth space, and these projections, or "teeth," mesh with the teeth of the gears, thus gripping them at their base. One of the spiral gears is shown at *B* in this illustration.

The machining of the engine bases and oil pans present some peculiar problems. They are made of bronze and aluminum in order to combine strength with lightness, and the nature of these materials has necessitated the design of special holding fixtures that may be securely clamped for the different machining operations without danger of distortion. An instance is found in the design of the fixture which has been constructed for holding the oil pans during the milling operations on their top surfaces. A heavy and rapid cut is taken over a wide area and it is imperative that the work be securely held, yet all stresses must be carefully balanced, to prevent springing and distortion of the thin aluminum sections. The holding fixture is shown, Fig. 14, with the oil pan in position, and in Fig. 15 one of the holding plates has been swung open and the pan removed, disclosing the internal arrangement.

Each of the columns (of which there are eight) that support the work is arranged as shown in Fig. 16. The work when laid on the fixture rests on the studs *A*, which are supported by the springs *B* which hold them against the face of the casting, thus insuring a support at each of eight points. These springs are so designed that they are not sufficiently strong to sustain the weight of the casting, and the latter settles until it comes in contact with fixed stops which determine its height in the fixture. The serrated lever jaws *C* are then brought to bear by means of the handwheel and screw *D*, insuring that the casting will stay down. The operator then turns the adjusting screws *E* beneath the spring-actuated supporting studs *A*, causing them to become fixed stops capable of sustaining the thrust of the cut. In order to insure that there shall be no slipping of these studs they are beveled, as indicated at *F*, and the end of the holding screw bears on this bevel and prevents the stud from slipping down. On completion of the work when the jaws are released and the piece lifted off, the spring *B* raises the studs until the bottom of the notch catches on the end of the screw *E*, which prevents it from coming out of the hole.

The inside holding plate *A*, Fig. 15, is also provided with serrated jaws, and serves to stiffen the inside of the forward end of the oil pan, which is not provided with a cross-web at this point.

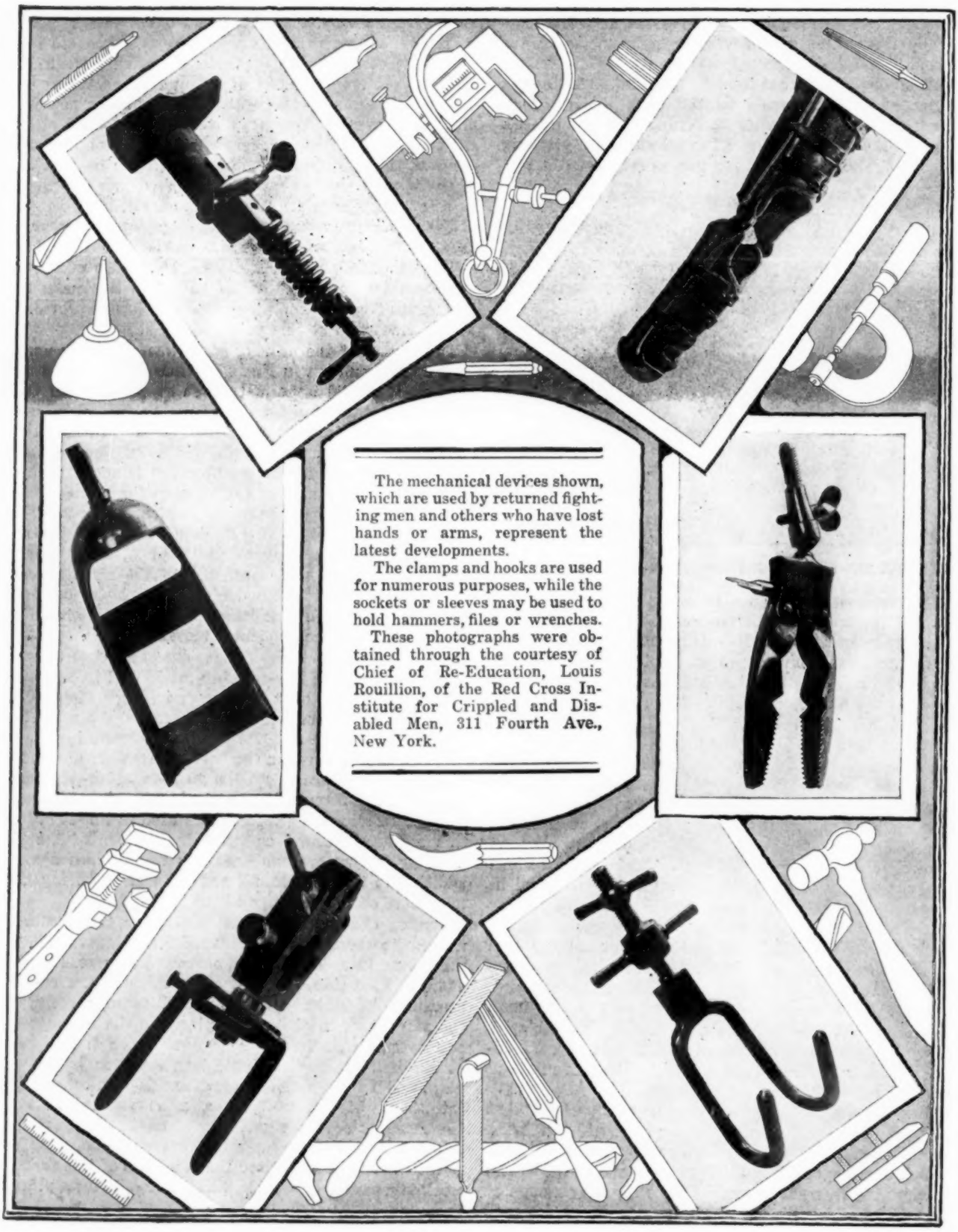
The boring of the bearing seats was originally done on the fixture shown in Fig. 17, which was mounted on the bed of an old lathe and which supported both the casting and the boring bar. A new horizontal boring machine has just been completed, Fig 18, on which the casting is turned upside down, and a long boring bar reaches the length of the machine and is supported at both ends. The same bar can be used for boring castings for all lengths of engines, which, as previously noted, vary from 4 to 12 cylinders each. The boring bar is carried by a geared-drive head *A*, which slides in ways and is moved lengthwise of the machine bed by a rack and pinion under control of the capstan wheel *B*. The bar has no lengthwise movement relative to the head, and consequently movement of the latter provides the feed.

A large four-bar line-reaming machine, Fig. 19, was also designed and built by the Van Blerck Motor Co. for reaming the crank and camshafts of the cylinder-base castings. Two of the bars are shown in place; they are slipped through the bearing brackets and individual reamers are slipped onto this arbor-like bar, being spaced between the series of bearing brackets shown. In all there are four bars used in line-reaming this casting, because, as the cylinders are of the T-head type, there are two lines of camshaft bearings in addition to the crankshaft, and the fourth boring bar takes care of the bearings of the timing shaft.

During the assembling of the motor the peculiar-shaped framework, Fig. 20, is used for rolling the motor units over in order that the operators may readily get at the under side of them. Throughout most of the assembly the sector of the circle shown uppermost in the view is at the bottom and carries the motor base and cylinders, but when ready to put on the oil pan and adjust the bearings the larger sector is put in place and bolted up, and the machine is then rolled over into the position shown. When in the reversed position the short sectors are removed to place the oil pan; then replaced and the motor rolled back into an upright position. It will be noticed that the base of this framework is mounted on wheels, which allows it to be moved freely about the shop.

Mechanical Hands and Arms

BY J. A. LUCAS



The mechanical devices shown, which are used by returned fighting men and others who have lost hands or arms, represent the latest developments.

The clamps and hooks are used for numerous purposes, while the sockets or sleeves may be used to hold hammers, files or wrenches.

These photographs were obtained through the courtesy of Chief of Re-Education, Louis Rouillion, of the Red Cross Institute for Crippled and Disabled Men, 311 Fourth Ave., New York.

Community Guarantees for Piece Prices

By JOHN C. SPENCE
General Superintendent, Norton Grinding Co., Worcester, Mass.

This article points out very clearly the high cost of unskilled labor and the economy of real producers even at high wages; it shows how the man who doubles the output of his machine adds greatly to the shop equipment without increasing plant investment; that double wages are cheap in comparison to the shop efficiency and the profits. The suggestions for the establishment of training schools, of suitable personal relations and the guaranteeing of agreed wages by the manufacturers of the community, are all worth careful consideration.

TRAINING in industry is a very broad subject and the idea conveyed to one's mind by the word depends almost entirely on the occupation or experience of the individual. Because of the great demand for workers of all sorts during the past four years, every essential industry has been compelled to train people, either consciously or unconsciously.

This training ranged all the way from the very simplest possible performances to those requiring extreme skill. I have seen a former inhabitant of the Balkans absolutely stuck when the two-wheeled freight truck he was pushing steered over against the wall of the factory. Nobody had taught him what to do in such a contingency, and he had not enough intelligence to back the truck away from the wall, cramp it around and go ahead.

I have a friend who operates a foundry. He was compelled, finally, to accept common laborers of such low intelligence that they could not, without training, steer a wheelbarrow down a foundry lane 4 ft. wide without smashing the molds that defined the lane.

The form of training that concerned us during the past four years and especially during our own participation in the war had to do principally with the item of productive operations only. We had no time to enter into the training of executives. These we created by the simple process of filling the gap with whatever we had on hand, being fortunate if the candidate had anything beyond his manual skill to recommend him. No organized, definite movement had been made to better these conditions, and, in fact, the question did not receive the serious attention of either the Government or of industrial organizations until we ourselves entered the war. The common practice from August, 1914, and on, was to go out and get your neighbor's workers away from him by hook or by crook—mostly by crook.

Stealing Labor From Each Other

The common method was to send a representative to establish himself at a hotel in a busy community, to study local conditions as to wages and hours and to advertise for certain specified types of workers at rates that would attain his object. Most of us have been guilty of either this method or the similar though less public and more efficient one of sending a man, who knows his business, to a community and using no publicity whatever except the passing of the word from one workman to his fellows. A smart man can, by this method, if backed by a generous corporation, absolutely skin a small community of all its best workers. I know this to be so because I have done it and could easily do it again. Too many of us had a "community conscience" in labor questions that had been created by social contact with executive neighbors, which did not extend outside of our own town. In the end, however, the effect was the same whether we hurt our immediate neighbor or a remote labor competitor. We were all trying to put six pieces in seven places and each of us wanted all six for himself.

Employment managers held expensive and unsatisfactory conventions where people told how they had obtained thousands of new employees without injury to their neighbors by means of this nostrum or that; by group insurance, by all kinds of bonuses, by speech making, back clapping, hand shaking, and by making it a point to daily ask Jack or Jim: "How are the wife and kids today?" These things are all fine when they come from the heart instead of the head. I believe in them and know that they were common practice before the days of these conventions and will be long after; but those of us who knew exactly what was going on, realized that either the speakers were entirely theoretical men whose integrity we did not question or else they were men too busy with affairs of management to have learned the exact details of how the job was being done.

Making the Start

After a time certain executives realized that someone would have to start the movement of training the unskilled into skilled or semi-skilled workers. Those who attempted to revive the scheme of training realized that it was more or less of a philanthropic effort, as, unless practically all took hold of it, the addition to the supply of workers would be of small consequence. However, someone had to make the start hoping that, if the plan was worth while, others would see the light.

In 1915, the Norton Grinding Co. started a training department because of the drain in skilled help caused by the vast increase in munition work, tool work, etc., in Worcester and neighboring towns. Our work consists in making high-grade grinding machinery We use all of the machinery in use in any machine shop or automobile shop. Hence, our problem with workers is similar to that of a great many firms.

We found that the regular foreman in charge of production did not have the necessary time to give to the breaking in of green help or of help that had obtained only a partial training at other shops. We believed it would pay to have a separate training department to which all beginners would be sent and remain there long enough to learn the rudiments of machine-shop practice. We do not pretend to turn out skilled machinists from this department, although in the cases of those who have shown a natural gift for mechanics, it has been a revelation to see with what rapidity they have learned.

Our training department is in a gallery of one of

our mills and is 23 ft. wide x 264 ft. long, an area of 6072 sq.ft. The department has its own tool crib operated under the same system as those in the regular production departments, its own washrooms, and toilets separate from the rest of the plant. The general opinion in the shop is that the department is a good scheme. The shop foremen have orders not to hire any unskilled help to be used as producers without first consulting with the supervisor of training.

Keeping In Touch With New Men

The supervisor is furnished with a list of all new employees, so that he can check this item and get into immediate touch with new men, who may have come in under a misunderstanding concerning their ability as workmen, and who might make good if given some further training. This assures the learners in the training department of obtaining the opportunities to get into the shop and at the same time, does not prevent the foreman from getting anyone, in whom he is interested, into training. When an opening in the shop presents itself, the supervisor selects from the school the person he thinks will best fill the place.

The length of time the worker has spent in training has practically no bearing in the case. Some workers, in a few days, due to natural intelligence and ability, or due to the fact that their judgments have been matured by years of experience in some form of mechanical work, are better fitted to take shop jobs as operators than are other men not so fortunate.

After a worker leaves the training department and takes a job in the shop, the supervisor still continues to keep in touch with him for several weeks. This often saves workers from discouragement, due to strange surroundings and the feeling of incompetence we all have when in contact with a proposition that bewilders.

In addition to the teaching of the purely manual side of the job, we try to instruct the beginner along the lines of what we expect from him as a man in relation to his fellow employees and the owners of the business. Rather than let him find out by haphazard contact, he is instructed how to conform to our time-keeping system; how to get tools from the crib; his responsibility with regard to these tools; the necessity for decent care on his part to coöperate in our sanitary and safety arrangements; his right to a square deal both with regard to advancement and to protection against injustice in connection with piecework.

Now that the war is over we are using our training department to take care of men who are returning from the service and to whom we have guaranteed jobs, as well as a means of placing employees who are convalescing from either sickness or injury. The future usefulness of our training department will lie partly in the training of a few beginners, enough to maintain the supply of skilled labor, but also as a means of producing inspectors, group leaders, foremen, rate setters, engineer beginners, demonstrators and salesmen.

Changed Ideals of Management

I believe we all acknowledge that the ideals of management, as a whole, have changed very much for the better in the past 30 years and especially in the past 10 years. This has been due not alone to pressure of public opinion or fear of organized labor, or drastic legislation, but to the fact that through business associations we have all become acquainted with each other and have gradually learned that narrow-minded management in our own particular factory eventually means trouble to other factories.

Granting that most managers have at heart the absolutely square deal with employees and even go so far as to organize good employment departments, health and sanitation departments, make the factories safe from hazard, desire to have the men earn more money than ever before, provided an adequate output is given: granting all this, of what avail is it unless the staff officers, the line officers, the sergeants and the corporals of the establishment are intelligently taught not only to understand the exact policy of the firm, but to actually carry it out? How are we providing ourselves with foremen, inspectors, engineers, etc., when we have the misfortune to lose a man we have considered satisfactory, or when we create a new department or expand an old?

We are, as a rule, simply promoting somebody whose only known quality besides his skill as a workman is his probable loyalty to the firm. Both of these qualities are necessary and oftentimes, by luck, the man has many others of value, but it is no credit to our ability as executives that he possesses them.

How is a man, who has spent all of his working life as a lathe operator or general machinist, going to be of much value to you unless you deliberately set about training him for his new job?

The Men In Contact With the Workers

Men in industry who have the duty of making decisions, whose functions are those of an executive even in the slightest degree, even the straw-boss, represent the corporation in the mind of the worker, and your success or failure in carrying to your workers the ideals of management that your higher intelligence dictates to be good business depends in the main part on these men. Every corporation, no matter what the size, should deliberately set about the selection and training of a group of young men, adding to this group each year as in any school, with the purpose in mind that out of this group, whenever possible, shall be selected the men to fill vacancies in places of responsibility. Sons of present employees, of known soundness of character, graduates of high schools, trade schools, and technical schools can be interested in such a plan.

Not only the manual side of the business should be taught as in the case of the old apprentice system, but much attention should be given to the understanding of the shop systems, costs, ideas of efficiency, public questions having to do with industry, etc., and above all, particular attention should be paid in the case of all those who show evidence of having sufficient merit to finally become executives, to the proper understanding of those questions that we group under some such heading as "employees' relations."

A good foreman should not only know his job, from the production side, but should also make his job his profession and should know everything possible about his men. He should be a source of a lot of facts that you would not care to record as statistics. A visit to the home of a sick employee will often do more to make a different man out of a foreman, or out of a manager for that matter, than a whole lot of reading and lectures. A foreman should have a sufficient understanding of economic questions to help in the molding of the opinion of his men. The management of the business

should make it a part of management duty to see that the foremen obtain instruction of this nature. This can be accomplished by supplying good reading matter and by meetings.

This is an especially opportune time, as many industries have been forced by business conditions to operate at least one hour per day less than during the war. Why not use at least one of these hours per week for a foremen's meeting? There is plenty of talent in every community for a supply of good common-sense speakers on subjects that your men ought to hear about.

What the foremen can do was well illustrated in the various national drives of the past two years. How would industrial establishments have made such a wonderful Red Cross and Liberty Bond showing, if the foremen had not taken hold of the work? Why not get the power of their united effort in helping to intelligently handle the questions confronting us that have their strength in ignorance? We can get great results along these lines if we deliberately organize for it, but it will take an open-minded management willing to work. It cannot be done by hiring somebody to create a department for the handling of this kind of work and then forgetting all about it. This sort of thing, to be successful, requires the interest and time of someone who has the welfare of the business and the workers in his heart, and who has authority to make decisions and to spend some money that will not actually show money dividends.

Another great field for training is among the old employees of our firms, the men who have been with us for a considerable period.

Maintaining Wages

How can we maintain wages at the present standard, if conditions return to normal and world trade is again without the restrictions forced by war? There is only one way and that is by means of increased output at normal unit prices.

The problem of increased production from workers already supposed to be skilled to some degree is so big that I will touch on only one phase of it, that part of our production that is performed under a piece-rate or premium plan. To my mind the day-work shop is almost a hopeless proposition from an efficient standpoint unless the goods are made in such quantities that a daily stunt can be readily established and then the plant really becomes a piece-work shop paying day wages as in the case of the Ford company.

The main causes for inefficiency in an open shop are, (*a*) insufficient equipment and facilities, (*b*) failure to supply material, (*c*) insufficient training, (*d*) lack of proper instructions even though the worker is trained, (*e*) intentional restriction by the worker. Management, in my opinion, is responsible for all of these. In the attempt to eliminate them lies the greatest opportunity for industrial training that exists today, because the process of attempted elimination involves the training of the worker already somewhat skilled and also the training of the management.

In attempting to make clear this statement let us consider the present conditions of the piece-work system in our industries. You can find plenty of proof, if not in your own firm certainly in many others, that men have increased their hourly earnings during the past four years by as much as 100 per cent. without any change in working conditions or in price per piece. Gradually, as the cost of living and the going wage of the community went up, these men produced more and more. There are examples of machines built before and during the war on a piece-work basis whose net labor costs have not increased in percentage anything like the increase in the cost of living or the cost of labor paid by the hour.

I believe that unless some action by the management were taken to prevent it, the hourly earnings of these same men will gradually drop again in unison with the cost of living and going wages. If anybody doubts these statements, he either does not need any further training himself, having already perfected his entire system of doing business, or else he has not, as I have by personal experience, learned the constitution and by-laws of the piece worker.

Let us frankly inquire into the reasons for these conditions. In speaking of restricted production most people give the impression that it is wholly the fault of the worker. This is not so, except in the case of certain closed shops where output is dictated by shop committees. In other shops it is mainly a fault of management of the past, and the management of the present has not, as yet, done anything worth while toward permanently eradicating it.

Why Men Hold Back

The worker has two main reasons for holding back. First, the price may be cut if he earns what the understanding in his particular shop says is "too much." Second, although his firm has stated that prices, once set, will not be cut, even if he believes it, he has brains enough to know that excessive earnings will result in lower rates being set on new work of a similar nature. This line of reasoning applies to the shop where rates are set from time-study methods as well as to the shop that sets rates based on a long record of past performances of a given operation.

The worker uses the same common sense that keeps you from winning the 2.20 trotting rate in 2.10, provided the prizes in both classes are exactly equal, or those in the 2.10 class are not enough better to pay for the extra effort.

Almost without exception, any present-day manager will tell you that it is the policy of his firm not to cut piece rates, but you have not, as yet, convinced the worker that this is so. He has only your word for it. Individually, he will probably believe you, but collectively he will not really believe, and the traditions of his training created by the history of the not very recent past will forbid him to "kill the job." As long as he can restrict production and get along with you, he is going to do it, and you are not going to get the full measure of his efforts until you establish some form of guarantee that eliminates his fear of your power over his earnings.

This reasoning applies in great measure to day work also, since in addition to the fact that there is not even the incentive of piece work, the worker is more or less conscious of the fact that piece rates may be set. How then can these faults be in great measure overcome and in such a way that the results will be just and permanent?

I believe this one question of piece work, properly adjusted, would be a big stride toward the settlement of many of the troublesome problems that today exist in American industry, at least. To begin with, in the

proper handling of this question, management must train itself or be trained by associations like this to cease to have in mind any sum that is "too much" for a worker to earn. So-called "efficiency experts" must cease talking about "exorbitant" rates or "unbalanced" prices. There is not a man in the industry who would set a figure that is "too much" for him to desire in return for his services to the world.

The manager who sublets parts of his work to an outside jobber and is content to get the goods at what he considers fair prices, without knowing how much profit the jobber has made by ingenuity or increase in production, should certainly rejoice to learn that he has the ingenuity and increased effort in his own plant and should be doubly glad to know that one of his own people, instead of a stranger, got the benefit.

In attempting to eliminate the causes for reduced output, each factory must solve all for itself with the exception of restricted production on the part of the worker. This you cannot solve as an individual for the reason that you have inherited the sins of your predecessors, and your men, in great part, are trained for you by someone else. It will require the united action of the employees of a community or of associations to accomplish much toward gaining the complete confidence and with it the coöperation of the workers.

Therefore, I put forth the following proposition based on the assumption that managers may be ready to try any reasonable plan that might perhaps help to convince the public that our particular kind of industry does not need any form of public control or intervention.

Establish Minimum Standard Rates

Let some local association of manufacturers decide that its members will each establish *minimum* piecework hourly rates, varying with the kind of work if you wish; that each firm stands ready to prove the rate on each job through the performance of an authorized employee, skilled in the operation; and that henceforth there will be no such thing as a maximum that an operator will not be expected to exceed. Let the association decide that it is detrimental to the community as a whole for any firm to cut piece rates, or to establish rates so low that an operator cannot make at least the established minimum for that class of work. Let it be understood that each corporation will be entirely free to change its methods of production at any time without reference to anyone, but that the resulting operations will also be rated at not less than the minimum rate for the class of work involved.

Each firm would have the privilege of raising any or all of its minimum prices whenever it saw fit, but once published it could not lower any of its minimums, except by the consent of the association, that consent hinging on the decrease in the cost of a certain list of necessities of life. This should not be put into effect until about a month after the decision, together with reasons for it, had been published at least to the employees of the firms affected and preferably also to the public.

Give publicity to this entire agreement and print the names of a committee appointed to receive complaints of the violation of the rules of the agreement. Let the committee be composed of owners, managers and workers, all of whom own real estate in the community and have been connected with their firms for, say, three years. I believe that where a single corporation could not gain the utmost confidence of its employees, that the publicity of such an agreement would not only hold reluctant firms to the practice thus established, but would, at once, get the coöperation of the more intelligent of the workers. This is not a minimum-wage scheme because it does not guarantee a definite wage, but holds out the pledge of a community that any worker, capable of earning as much or more than the management is satisfied to call a day's work, will be permanently protected even to the utmost use of his skill.

What has this to do with training? If your piece rates are intelligently set by skilled operators, you will find that many workers will fail to earn up to the established minimum. These are the men who heretofore have been getting their training by the "hire and fire" school. They learned a little from one shop and were fired when conditions made them no longer usable, then they caught on somewhere else and got a little more experience, but never were they intentionally given intelligent attention.

If, under the plan outlined above, you also keep a record of the performance of each individual worker, you will find those who fail more than a certain predetermined amount below the minimum, and know that it is not economical to have them continue to tie up your investment. These are the workers who should receive the attention of your instructors, who should preferably be the same men who help you to set the rates. The result ought to pay its own way, if our experience along these lines during the war is any criterion.

High Wages Increase Your Profits

If, by reason of long practice and skill, a worker earns a great deal more than what satisfies you as a day's work, pay attention to this event also, but not the old-fashioned kind of attention that has helped to foster restricted production and distrust. Rather, let whoever is now the equivalent of the "old man," or at least someone in authority whose notice of a worker has heretofore been an event talked about in the shop, go out and congratulate the winner and let him actually know that you are grateful to him for enlarging your establishment free of charge. Here is another opportunity for management to train itself. It may come a little hard at first. Certain under-developed portions of the business anatomy may, like an athlete's muscles, be a little lame, at first, notably the pocket nerve and the square-deal impulse; but like the athlete's muscles, these parts will soon develop so that the harder and rougher the game becomes the more you will enjoy it.

After a short time you will get to a point where you will not try to hinder anybody from enlarging your plant as much as he pleases, provided they still continue to do it free of all cost to you and, in fact, actually insist on paying you something for the privilege. For this is what happens when you increase output from the same plant investment.

If this plan as outlined does not suit, at least that part of it that deals with the training of those workers supposed to be skilled, but whose records show them to be poor producers, should be carried out. To do this will involve also the establishmnet of what you consider a day's work. This requires men skilled in the operations under consideration and since no one likes to ad-

mit that his firm cuts prices, the only remaining part of the plan is a community pledge.

Compare this with plans dictated to industry by the War Labor Board and see which you prefer, remembering of course that a great many people, with votes, are saying that industrial management, to date, is a failure. Compare the effect on the reputation of any association of manufacturers in trying to do something like this, as against the present reputation of such associations with the workers, because to him they stand for belligerent organizations, even though he may be wrong in his belief.

I would like to see the name of the associations of manufacturers synonymous with progress, community spirit and prosperity for all in the minds of workers.

Automatic Tapping Machine for Pipe Fittings

By J. H. Vincent

The large quantities of pipe fittings required to meet the present demands of the trade have necessitated the invention and design of machines for their rapid production. In the smaller sizes the work to be done is limited to tapping the threads that receive the pipe ends, and special machines capable of producing a large number of fittings, completely tapped, with a small relative expenditure of manual labor, have been built for this purpose.

The machine in Fig. 1 was designed and built in the shops of the Jarecki Manufacturing Co., Erie, Penn., for tapping elbow fittings, commonly known as "ells," and is so constructed as to deliver two finished pieces at each cycle after the turret is filled.

How the Work Is Held

The work is held in the square turret *A* which rotates upon a horizontal shaft *B* carried in bearings in the upper ends of two arms, one of which is shown at *C*. This enables the turret to be swung back from the working position to be rotated much the same as the well-known turret of a screw machine.

The arrangement of the turret is shown more clearly in Fig. 2. Two clamping fixtures *D* upon each of the four faces hold the ells, two of which may be seen at *E*. The clamping jaws are operated by a wrench that fits on the square-headed screw *F*. Two castings are tapped at a time, but as there are two operating positions there are four operations going forward. The turret is shown in tapping position in Fig. 1, but in Fig. 2 it has been partly turned to display the detail to better advantage.

The cycle of operation will be better understood from the diagram, Fig. 3, on which the parts have been lettered to correspond with the other views. The clamping fixtures shown at *H* are ready to be emptied and refilled by the operator.

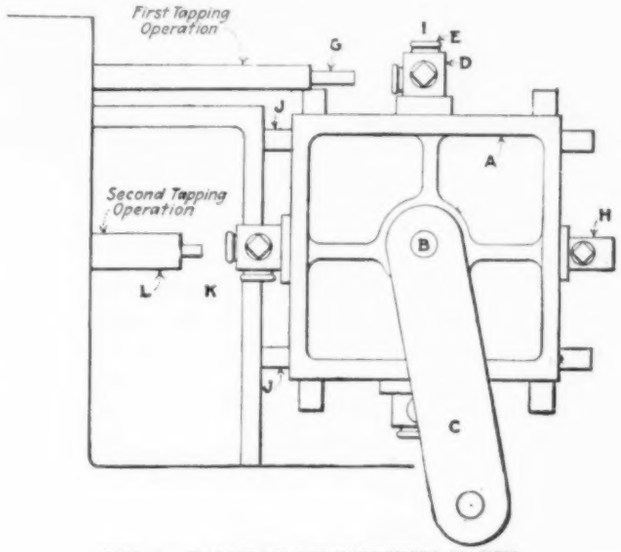


FIG. 3. DIAGRAM OF WORKING PARTS

The arm *C* swings the turret sufficiently to the right to clear the corners during its rotation. This brings the previously filled fixture and work into the position *I*, and the arm *C* returns the turret to the left until the stops *J*, of which there are four on each face of the turret, come to a bearing against the main frame of the machine. The spindle *G* then comes forward until the casting is tapped to the required depth and the tap withdrawn. The frame is then swung to the next position, bringing the pieces first tapped into the position *K*, where the other end of the ells are presented to the second set of taps *L*. In the meantime a freshly filled fixture has swung another pair of castings to the first tapping position, so that from now on two sets of taps

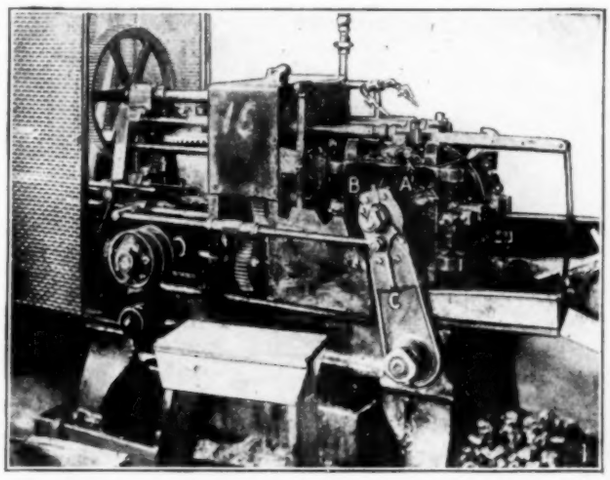


FIG. 1. MACHINE FOR TAPPING ELBOWS

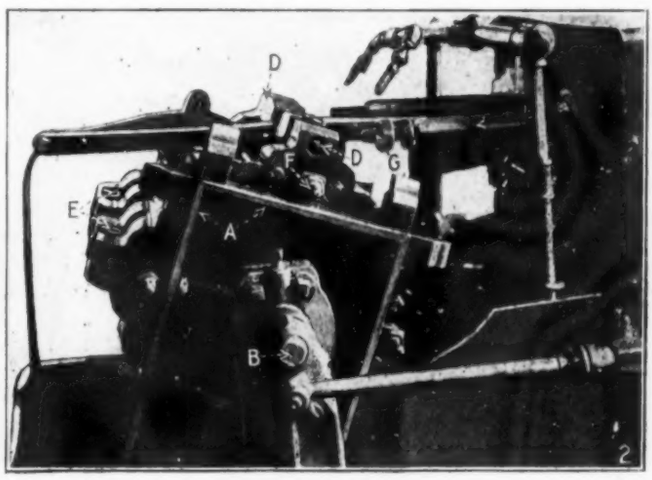


FIG. 2. NEARER VIEW OF TURRET

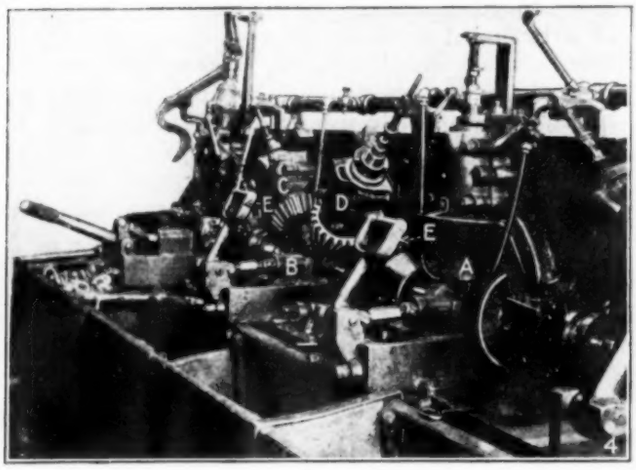


FIG. 4. DIFFERENT FORM OF TAPPING MACHINE

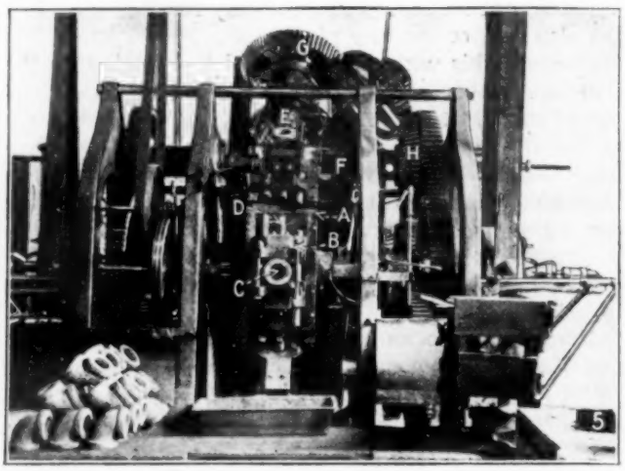


FIG. 5. MACHINE FOR TAPPING LARGE FITTINGS

are continually working and two complete elbows are finished at each movement of the turret.

It will be seen that from the nature of this arrangement the two ends of the elbow will be tapped at right angles to each other within the limit of accuracy of the machine, therefore the trouble often experienced by pipe fitters, caused by inaccurate tapping, is eliminated.

Another type of machine extensively used for tapping pipe fittings is shown in Fig. 4. Owing to its position only a portion of the machine, about one-half of its total length, is illustrated, but the remainder consists of similarly constructed units which are so arranged that they may be handled by one operator. Several of these machines are in service in this department of the plant, and are used for tapping larger sizes of fittings than the machine shown in the preceding illustrations.

THE OPERATIONS

The unit *A* is tapping the three outlets of a tee. The other unit *B* is operating on an elbow, which is clamped into position to receive the taps on the two spindles *C* and *D*, which are set at an angle of 45 deg. either side of the vertical. The pieces are clamped and the taps started by means of the handle *E*, but as the pressure required for operating these handles is considerable they are now being replaced by air cylinders which will reduce the amount of manual exertion required, and the machines will then be suitable for operation by women.

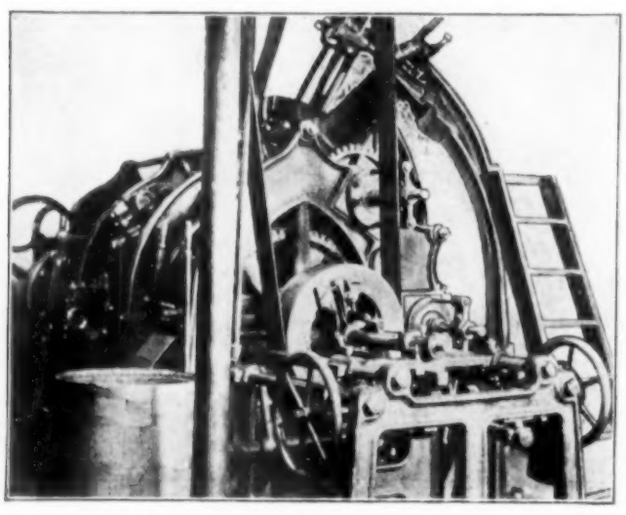


FIG. 6. DETAILS OF ITS MECHANISM

The machine shown in Fig. 5 is capable of handling 6- and 8-in. pipe fittings. It is similar in principle to the machine shown in Fig. 1 in that it has a revolving turret, or center frame *A*, upon which are mounted the fixtures *B* which hold the fittings to be operated upon as at *C*.

As the turret is turned upward and toward the back of the machine the work is brought into alignment with taps carried on the spindles *E* and *F*. These spindles are driven by the large bevel gears *G* and *H* and are automatically fed forward, tapping into the casting to the proper depth and then withdrawing. The turret of this machine has six positions.

Another view of this machine, Fig. 6, shows some of the operating mechanism, an idea of its size being gained from the fact that it stands about 14 ft. in height. The operator who places the work in the turret stands on a platform about 2 ft. above the floor level. The machine has three spindles and may be used for tapping tees as well as elbows.

Drill With Lip of High-Speed Steel

BY F. R. IRWIN

The sketch shows a drill which the writer has used for a year with excellent results. The body of the drill is chrome-nickel steel, heat-treated and ground. The cutter is of high-speed steel held in the end of the body with taper pins. The body of the drill always has plenty of clearance and never binds in the hole; it

INSERTED LIP DRILL

also has the advantage of an oil channel through the center. When the cutter wears small it can be replaced at a very small cost; the body of the drill will last indefinitely and thus retain its capacity for drilling deep holes. The first cost is much less than any other oil-tube drill.

Following are some records which the writer has made: $1\frac{7}{16}$-in. hole, 180 ft. in 40-point carbon steel at the rate of $1\frac{1}{2}$ in. per minute; $2\frac{1}{4}$-in. hole, 140 ft. in 40-point carbon steel without regrinding.

ARMY ORDNANCE NEWS

Manufacturing the 9.2-In. HOWITZER SHELL

By S. A. Hand,
ASSOCIATE EDITOR, AMERICAN MACHINIST

Part I. Machining Operations

This article describes and illustrates the operations in manufacturing the 9.2-in. howitzer shell, Mark IX. It includes cutting off the open end, drilling the nose, rough- and finish-boring and rough-turning. Drawings of some of the gages used are also included. Further operations will be taken up in articles that are to follow.

THE data and illustrations for this article were obtained during a visit to the plant of the American Brake Shoe and Foundry Co., Erie, Penn.

The forgings from which the 9.2-in. howitzer shells are made are furnished to the manufacturers by the Government and are the product of three forging plants. They weigh about 380 lb. in the rough, and the specifications state that the steel from which they are made shall contain: Carbon, 0.45 to 0.63 per cent.; manganese, 0.50 to 0.90 per cent.; sulphur, not over 0.06 per cent.; phosphorus, not over 0.06 per cent.; silicon 0.10 to 0.35 per cent. Test pieces taken from the forgings shall have a tensile strength of not less than 89,000 lb. nor more than 110,000 lb. per square inch of section. The forgings are conveyed to the shop by a traveling crane equipped with a magnet. From shop door to first operation they are rolled along the floor by means of a pipe shaped as shown in Fig. 1. After machining operations have been begun nearly all the handling is done by light chain hoists running on overhead rails and by rolling along benches placed between machine rows from one operation to another.

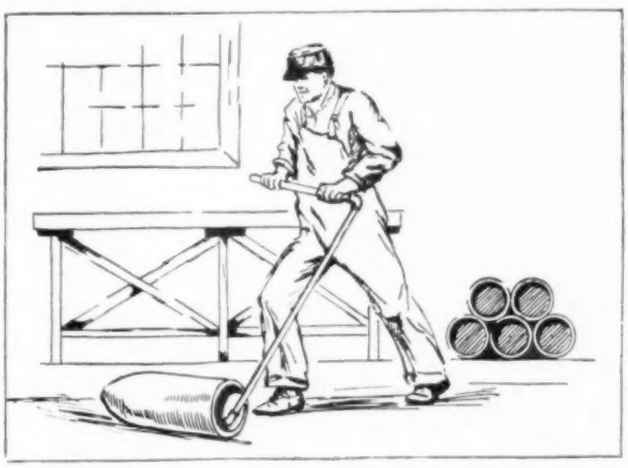


FIG. 1. HANDLING FORGINGS ON THE FLOOR

All machines are located so as to avoid any back tracking between operations. Nearly all work-gripping devices, both internal and external, are hand operated. All cutting oil used is mineral lard oil, and all cutting compound is 20 per cent. Damascus soluble oil and 80 per cent. water.

Every shell is inspected between operations. This keeps the operators constantly informed as to the amount of their work passing inspection and the number that they will be paid for. This avoids disputes on pay day. The output is from 1200 to 1500 shells per day of 24 hours.

Fig. 2 shows the outlines of the forging and the finished shell and Fig. 3 shows finished shell and details.

Each shell is stamped with a serial number as soon as it reaches the shop and a record is made of the heat number. If this number will be obliterated in cutting off the open end it is stamped on the shell body. The first machine operation is to drill the nose. This is done on a Colburn upright drilling machine, Fig. 4.

On the base of the machine is fitted a two-station turret *A* carrying two upright expanding mandrels that fit the interior of the shell nose at *B*. In the illustration one mandrel is shown empty and the other is covered by the shell shown in the operating position. The shell is gripped near the base by three serrated buttons, one of which may be seen at *C*, spaced equidistantly around the mandrel and forced outwardly by the lever *D*. On this lever, near the bottom, there is a pawl which

ARMY ORDNANCE NEWS

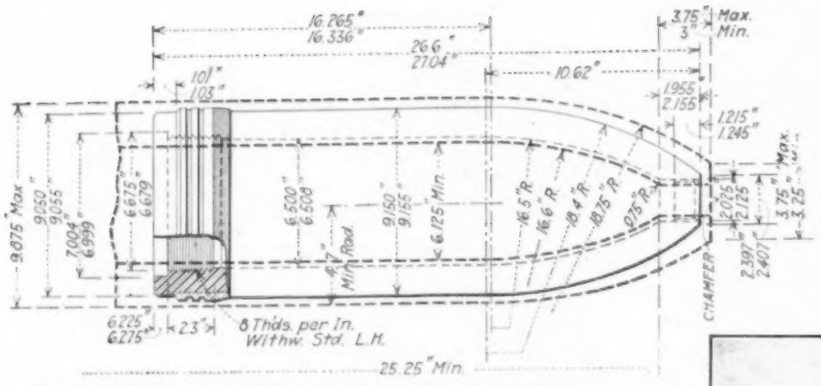


FIG. 2. OUTLINES OF FORGING AND FINISHED SHELL

engages in a ratchet segment (not shown in the illustration) and locks the buttons when in their expanded position. The whole arrangement holds the interior of the shell concentric with the mandrel. When the locking device is released the buttons are forced inwardly by the flat springs *E*.

SEQUENCE OF OPERATIONS

501.	Drill nose.	512.	Finish nose.
502.	Cut off open end.	515.	Turn copper band.
503.	Rough and finish bore and face base.	514.	Fit base plug (see operations on base plug).
504.	Rebore nose.	517.	Weigh.
505.	Rough-turn.	516.	Wash.
506.	Finish-turn and trim nose.	518.	Rivet base plug.
507.	Score, undercut and turn for wave.	519.	Weigh (check).
508.	Wave.	522.	Final shop inspection.
509.	Press on copper band.	520.	Varnish inside.
510.	Rebore, rough counterbore and round corner at base.	521.	Bake.
511.	Mill thread and finish counterbore.	523.	Government inspection.
		524.	Varnish outside.
		525.	Ship.

Over the shell shown in operating position will be seen a jig *F*, the base *G* of which is fastened to the face of the drilling-machine column while the jig proper is pivoted at *H* and fastened in place by a screw attached to the handwheel *I*. The lever *J* raises the turret from its bearings, enabling it to be more easily revolved, and a locking pin (not shown) locks it in either of its two positions. In practice a shell is placed on the outer mandrel, the turret revolved to bring it into the operating position and locked. The buttons are then forced out to grip the shell and drilling commenced. As soon as the drill has started to cut, the operator places a shell on the empty mandrel ready to be swung into operating position when the first shell has been drilled. A repetition of the former cycle is gone through, the drilled shell

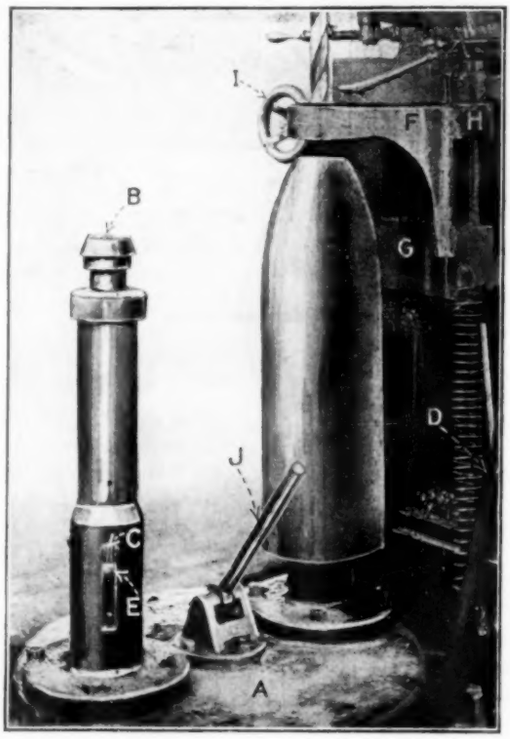


FIG. 4. DRILLING THE NOSE

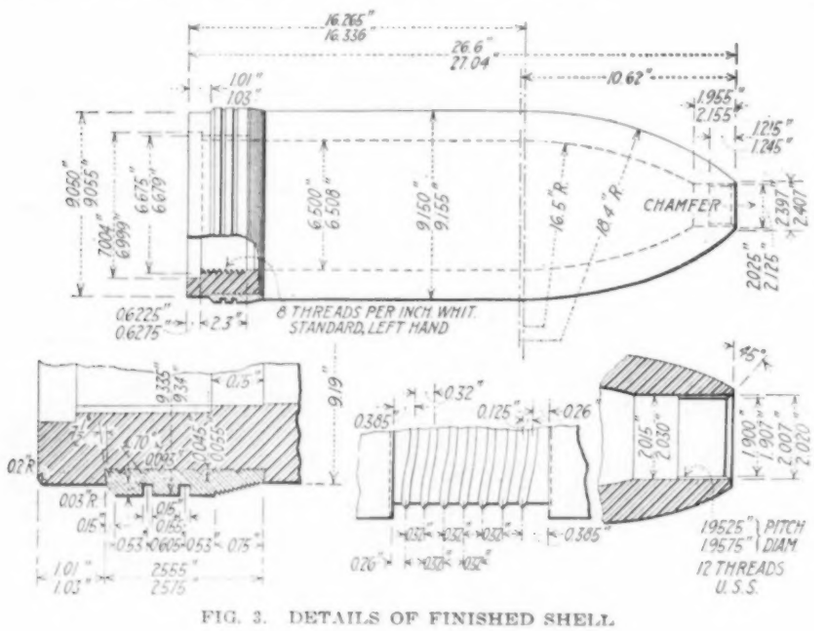


FIG. 3. DETAILS OF FINISHED SHELL

removed and another put in its place. By this arrangement drilling is almost continuous.

As the forgings are ragged at the open end and vary in length it is necessary to cut them off to true up the end and to bring them to a specified length. This length is measured from the bottom of the hole, so that in boring the amount to be removed by the end of the hog-nose drill will be uniform or nearly so. For this operation, Fig. 5, a Williams cutting-off machine is used. The shell is placed nose first within the hollow spindle of the machine and clamped by four heavy set-screws just behind the cutting-off tools. At the back of the spindle is a plug center which enters the drilled hole in the shell nose, centering it at the nose end. The base end is centered approximately by the four clamping screws, exact centering not being

ARMY ORDNANCE NEWS

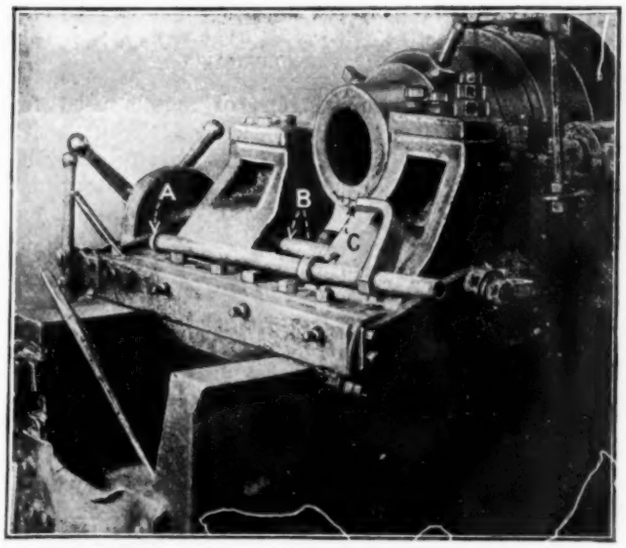


FIG. 5. CUTTING OFF THE OPEN END

necessary as there is an after-operation on the base after boring. Two high-speed cutting-off tools set in heavy tool blocks are used. One tool is at the front and one at the rear, both being simultaneously fed toward the center. The tool at the rear has the cutting edge at the bottom, as is necessary in machines of this type. A gage for setting the cutting-off tools the proper distance from the bottom of the hole in the shell is shown on the front of the machine. The end *A* is bottomed in the hole, where it is centered by the tapered sides of the nose interior. A two-legged spider *B* rests on the side of the hole near the base and centers the gage at the outer end. The front tool is set to the proper position by bringing the rear edge against the rear side of the notch *C*. Fig. 6 is a detail drawing which shows the construction of this gage, in which corresponding parts are lettered the same as shown in the half-tone illustration, Fig. 5.

The next operation is to rough and finish the bore

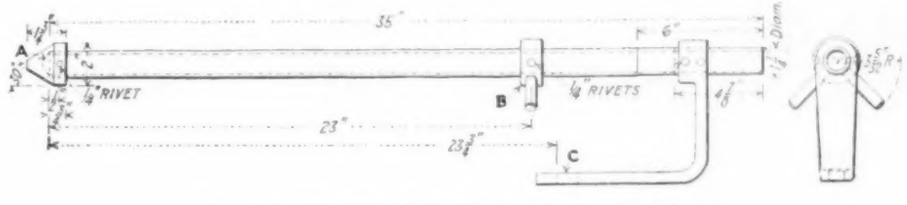


FIG. 6. GAGE FOR SETTING CUTTING-OFF TOOLS

and face the base, Fig. 7. This is done in a No. 23 Amalgamated boring lathe and the shell is held in a pot chuck, the outer end of which is run in a steadyrest that is an integral part of the machine. The shell is centered at the rear end by a plug center which enters the drilled hole in the nose in the same manner as in the cutting-off operation. The base end is centered by the hole. For this purpose a plug center is mounted in the end of the boring bar and brought up until the end enters the hole and is held tightly therein. While so held the shell base is clamped by the heavy setscrews seen at the mouth of the chuck.

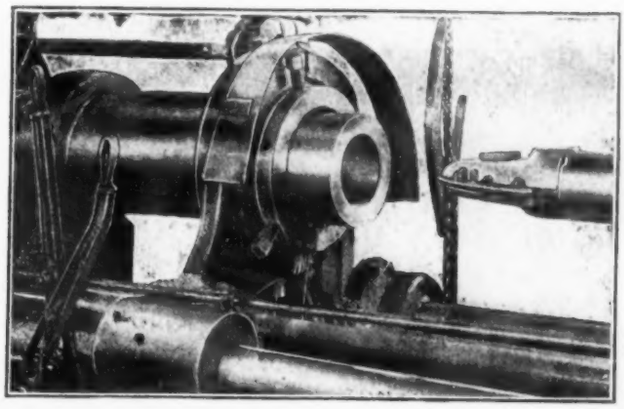


FIG. 7. ROUGH AND FINISH BORING AND FACING THE BASE

First a roughing reamer is used to remove the surplus stock. This is followed by a finishing reamer to bring the hole to the proper size and profile. Both reamers are fed by power while cutting the straight part of the hole, but when they reach the interior profile the power feed is thrown out and hand feed is used for the rest of the operation. This method has been adopted because of the liability of the reamers to hog in when cutting on the profile. If power feed were used there would be danger of breaking the reamer or twisting the boring bar before the machine could be stopped or the feed thrown out, but hand feed obviates this danger, it being sensitive and quickly controlled.

(This Article Will Be Continued in the May 1 Issue.)

PERSONALS

Second Lieut. Robert B. Kirkpatrick, who enlisted in June, 1918, and has been on duty at Camp Meade, has left the service. He was formerly employed by the Victor Talking Machine Co., Camden, N. J.

* * *

Capt. Edward F. McCrossin, of South Birmingham, Ala., who has served in the Nitrate Division, has been discharged. He is a mining engineer and a graduate of Ohio State University. While in the service Captain McCrossin has made some important mining investigations in the coal fields of Alabama.

* * *

First Lieut. Fred W. Lycett, whose home is in Hartford, Conn., and whose work in the service has been in connection with the Browning machine gun, has been discharged. He attended Trinity College and has been connected with the Charter Oak Motor Co., which is located in his home city.

The Use of Solders for Aluminum

Bureau of Standards Circular No. 78

The Bureau of Standards of the Department of Commerce has just issued under date of Jan. 28, 1919, Circular No. 78, which discusses the subject of solders for aluminum and gives the result of some tests with them.

The ever-widening use of aluminum in the industries has brought with it the question of how to make repairs. A permanent repair oxygen-gas welding is entirely satisfactory in many cases but there are some in which it is not desirable to heat the parts as much as is necessary with this process on account of the attendant distortion. In such cases a means of joining the parts at a lower temperature is sought and various so-called aluminum solders have been patented and put on the market for which extravagant claims are made. To determine the feasibility of soldering aluminum and the merits of the various soldering compositions a series of tests were made by the Bureau, the results of which together with those of previous investigations and current experience are given in this circular.

Resolved Into Two Questions

Whether aluminum can be successfully soldered resolves itself into two questions: (1) Whether the solder can be applied and made to adhere to the aluminum, and (2) whether the joint thus made is stable and does not deteriorate. The factors of strength, ductility, etc., are also to be considered.

The aluminum solders are usually mixtures in widely varying proportions of zinc, tin and aluminum and are applied by rubbing them into the heated surface of the carefully cleaned material, the process usually known as "tinning." The joint may then be made in the usual way with a soldering iron and the solder without the use of a flux which the Bureau tests showed to be useless.

The efficiency of the joint evidently depends upon the adhesion between the tinning coat and the aluminum. To test the efficiency of this adhesion, strips of alloy and sheet were carefully cleaned and coated with the various solders which was easily done in all cases. The tinned strips were then soaked in water for various periods of time and the results observed. Within 48 hours little blisters from one-half to two or three millimeters in diameter appeared in the soldered layer on all specimens. When the blisters were broken it was found that the metal beneath them had not alloyed with the solder. Within a period of 7 to 14 days the blisters increased until most of the tinned surface could be stripped off. In these tests it was noted that the solders which had the highest melting points gave smaller blisters and a better bond. This was attributed to the alloying effect of the higher temperatures. In addition to these symptoms the aluminum adjacent to the tinned layer was rapidly attacked and a gelatinous layer of oxide of aluminum was formed. Zinc-base solders were themselves attacked while tin-base ones were not. This action is hastened by the electrolytic action between the aluminum and the various elements in the solders all of which are electro-negative to aluminum and set up galvanic action in which the current flows from the aluminum to the solder.

Strength and ductility tests showed little variation in the former characteristic but a great deal in the latter, tin-base solders being exceedingly ductile while zinc-base ones were very brittle. The presence of copper or antimony or an excess of aluminum also produce brittleness which should be avoided as far as possible.

The strength tests indicated that the soldered joints were rarely as strong as the solder in a cast form. Failures occurred both in the bond and through the solder itself.

General Conclusions

1. All metals or combinations of metals used for aluminum soldering are electrolytically electro-negative to aluminum. A soldered joint is therefore rapidly attacked when exposed to moisture and disintegrated. There is no solder for aluminum of which this is not true.

2. Joints should therefore never be made by soldering unless they are to be protected against corrosion by a paint or varnish, or unless they are quite heavy, such as repairs in castings where corrosion and disintegration of the joint near the exposed surface would be of little consequence.

3. Solders are best applied without a flux, after preliminary cleaning and tinning of the surfaces to be soldered. The composition of the solder may be varied within wide limits. It should consist of a tin base with addition of zinc or of both zinc and aluminum, the chief function of which is to produce a semi-fluid mixture within the range of soldering temperatures.

SUGGESTED RANGES OF COMPOSITION

Tin-Zinc Solders:	
Tin	remainder
Zinc, per cent.	15-50
Tin-Zinc-Aluminum Solders:	
Tin	remainder
Zinc, per cent	8-15
Aluminum, per cent	5-12

4. The higher the temperature at which the "tinning" is done, the better the adhesion of the tinned layer. By using the higher values of the recommended zinc and aluminum percentages given above, the solder will be too stiff at lower temperature to solder readily and the workman will be obliged to use a higher temperature, thus securing a better joint. A perfect union between solder and aluminum is very difficult to obtain.

5. The joint between previously tinned surfaces may be made by ordinary methods and with ordinary soft solder. Only the "tinning" mixture need be special for aluminum.

6. There is no reason why a good solder for aluminum need be brittle as several commercial varieties are, and it is very undesirable that it should be.

7 The tensile strength of a good aluminum solder is about 7000 lb. per square inch. The strength of a joint depends upon the type and upon the workmanship. Much dependence should not be placed on the strength of a joint.

How Do You Prevent Oil From Discoloring Finished Surfaces?

When a machine tool comes from the builder its finished surfaces are things of beauty and shine with a mirror-like polish. If you do not oil these surfaces they will become scratched and marred, and if you do oil them they will before very long take on a molasses-colored hue that is far from being attractive.

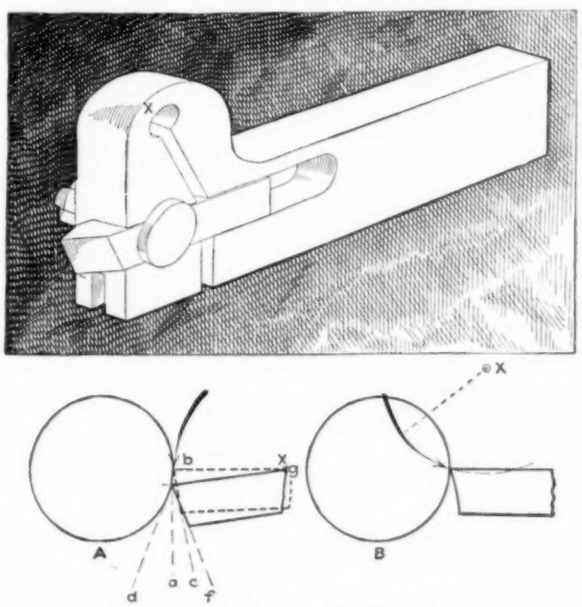
How do you prevent oil from discoloring the finished surfaces of your machine tools? We would like to have an expression of the experiences of our readers on this point.

Elimination of Chatter Mark

By William S. Rowell

Mr. Bach's remarks on the elimination of chatter marks, page 307 of *American Machinist*, can all be agreed to, but the two spring tools shown in his Fig. 2 do not conform to his ideas. The fault lies in the relative position of the cutting edge of the tool and the pivot about which it turns.

Fig. 2 of the article alluded to shows two common forms of spring tool, each holding a threaded-chasing bit or similar cutting tool. As spring tools are probably more often employed to obtain smooth cutting



PROPER FORM OF SPRING TOOL

in chasing threads than in all other work combined a little study of their action in such work might be time well spent.

It is plain that the spring of such a tool, may at the same time that it is giving a smooth cut, be the cause of serious defects in form. These defects are difficult to detect except with the most refined means of inspection most thoroughly and skillfully applied.

It is impossible to say just where the pivot point is in any spring tool, but it is plain that in form *B* it is not much above, and is far back of, the cutting edge of the tool. As the pressure on the cutting edge is almost wholly downward the movement of the tool will be in that direction. It may truly be said that a downward movement of the cutting edge will cause a lighter and probably a smoother cut to be taken, but the effect on both cutting edge and form of thread is much worse than if the pivot point were higher and not so far back from the cutting edge. A moment's inspection of diagrams *A* and *B* in the drawing herewith will make this clear.

We painstakingly grind our chasing tool to the correct angle for the thread to be chased, and we as carefully set the top face in the plane of the work center, all to obtain a correct thread angle. Now, if the tool is sprung below the plane of the work center, the thread angle is changed, and while it may be said that the finishing cuts will be so light and the consequent spring so slight that this may be neglected, another and very important point must be kept in mind, which is this:

While taking the heavier cuts before the finish cut, the tool is sprung below the center and is rapidly dulled because of increased clearance (see diagram *A* for increase of clearance angle caused by relatively slight deflection of the tool from *b* to *e*). Angle *abc* represents the clearance of the tool when its top is in the plane of the centers, as shown by the dotted lines. Angle *def* shows the enormously increased clearance angle when the tool is sprung to the line *eg*. This greater clearance causes rapid dulling and consequent loss of correct thread angle, which, once lost will not be corrected when a lighter finish cut allows the tool to return to the plane of the centers.

It should also be borne in mind that all springing of the tool tends to-out-of roundness. If the pivot point is as nearly directly above cutting edge as possible (see diagram *B*) the movement will be nearly straight back, thus avoiding any change of clearance and also tending toward a more accurate thread angle.

Much more may be said on this subject but I will only add that a spring tool as here shown has given excellent results and may be made at small cost. Pivot point *X* is above the cutting edge sufficient to insure almost a straight-back movement as the tool springs from cut.

Dial Feed Arrangement Used in Grinding Piston Rings

By J. J. McIntyre

A quick method of feeding piston rings by means of a dial attached to a machine for grinding them on the side is shown in Fig. 1, with a sketch of its arrangement in Fig. 2.

The machine used is a Persons-Arter rotary grinding machine equipped with a magnetic chuck. The feeding dial is mounted as clearly shown in Fig. 1, so that it just clears the surface of the chuck.

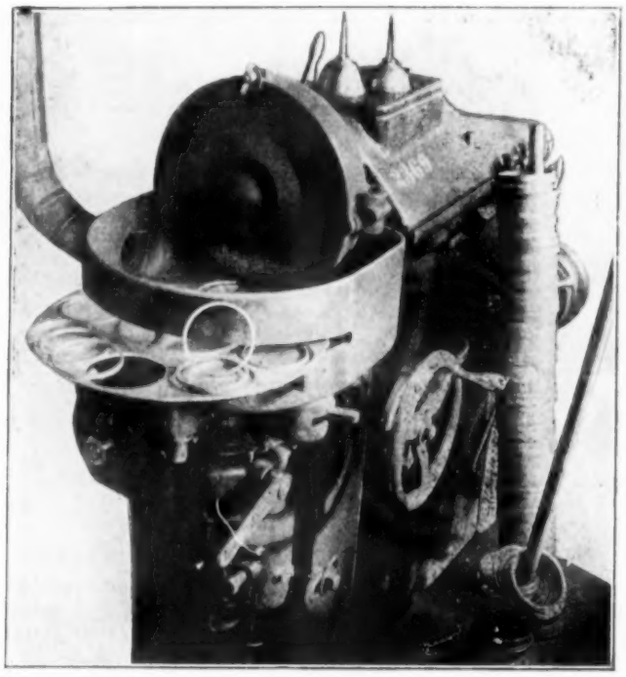


FIG. 1. PISTON-RING GRINDING WITH DIAL FEED

The rings are laid in the first hole to the right as the operator stands in front of the machine. The dial is turned by hand each time, the electric current being switched off and on the chuck at the proper time to release the finished ring and grip the next one.

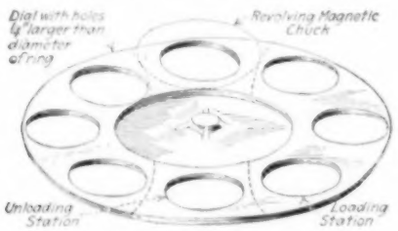


FIG. 2. DIAGRAMS OF THE DIAL

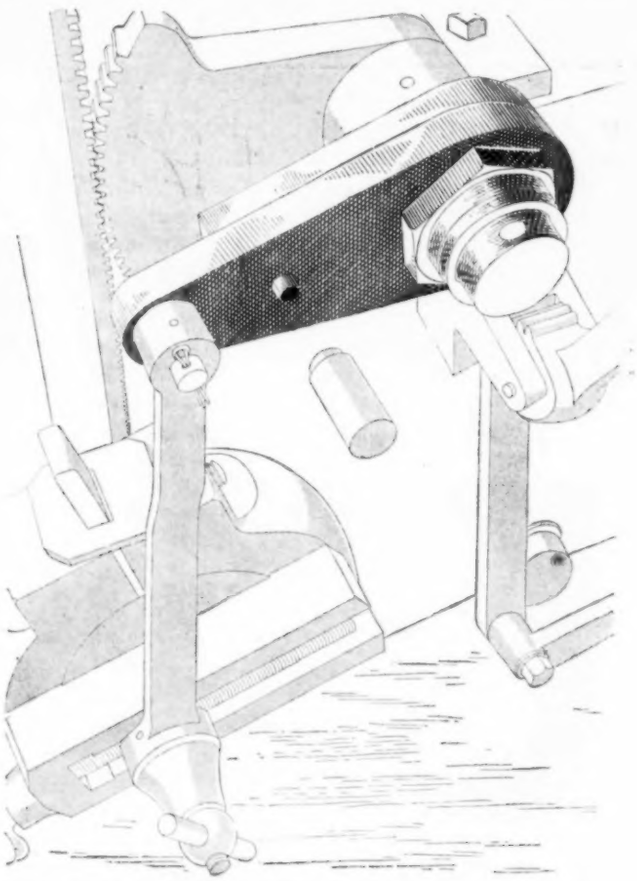
The holes in the dial are about ¼ in. larger in diameter than the outside of the rings to be ground, and it is an easy matter to bring each ring to a central position. As the finished rings reach the front position of the dial they fall through the hole and stack themselves on properly placed rods, two of which may be seen at the right of the machine. The rate of production is 200 an hour.

Safety Devices for Feed Mechanisms on Planing Machines

BY E. FERBER

The device shown on page 309 of *American Machinist*, providing a breaking point in the feed mechanism of a planing machine to protect other and less easily repaired parts from breakage, is good to the extent of its limited ability, but when made in the manner shown it serves as a safety valve only in one direction. If the conencting-rod had been shortened ½ in. and a bushing put over the joint, pinned to each part of the rod with the ends of the latter separated by the amount cut out of the rod, the device would have worked equally well either way.

The picture with this letter shows the same idea applied to a Whitcomb double-head planing machine, the construction of which lends itself admirably to this purpose, and the device prevents damage by reason of overrunning, or collision of the heads. The rock lever that operates the gear segment which is a part of the feeding train is made in two parts, the inner one keyed to the sleeve of the gear segment and the outer one, which is connected directly to the friction box, turning idly upon it. A number 10-32 iron hexagon-head machine screw joins these two parts together and



A SAFETY DEVICE FOR FEEDS OF PLANING MACHINE

offers sufficient resistance to operate the feeds under normal conditions, but shears readily under any unusual strain. This device has a great advantage in that its effective resistance can be increased or diminished by merely changing the radial position of the screw in the levers.

Salvaging Spoiled Work

BY PETER F. O'SHEA

In these days, when attention and money in large quantities are put on salvaging material to make by-products, a little intensive attention put on salvage within the confines of one's own factory is apt to pay very good dividends.

The special tap plant of the Greenfield Tap and Die Corporation, Greenfield, Mass., makes most of its small special orders out of pieces which have been spoiled in the course of manufacturing large orders. For instance, a large order of 1¼-in. taps goes through the works. The pieces which fall by the wayside are saved and collected, and sent into a scrap stock. Out of an order

SALVAGING SPOILED WORK

for 1000 taps of the size mentioned there may be 20 spoiled pieces. When a small special order of a dozen 1¼-in taps is received the blanks for them are not cut from bar or rod stock, but instead, 12 or 14 of the spoiled 1½-in. pieces are picked out and sent along as blanks for the 1¼-in. taps. If the thread has been turned on these pieces, the lathe man turns the blank down until the thread has disappeared and then cuts a new thread of the proper diameter. If the spoiled piece already has a squared end and a polished shank, it is probable that this squared end will do for the squared end of the new size and thus save an operation or two, besides saving the steel which would otherwise be thrown away.

These spoiled pieces are assigned as blanks for small special orders because these small orders have to be tinkered with anyway, the dimensions being irregular, and requiring a special machine set-up. This makes it practically job work. It would not pay to route these spoiled pieces as blanks for large orders of regular dimensions, mixing them up with bar stock, because the machines used on these orders are naturally set up for quantity production. Each small order, therefore, in this plant, has a requisition for steel routed to the man shown in the illustration. He looks over his pile of scrap, and almost always succeeds in picking out enough blanks for the order. If he does not succeed, he then passes a requisition along to the regular stock man, who takes the necessary material out of the bar stock shown in the background. The salvage man, as he is called, makes it a point to pass along very few orders to the regular man. He much prefers to poke around and discover pieces enough that can be cut off to the proper length with the cutting-off saw. In this way he has made himself a valuable man for the company.

A Handy Stock Rack

By W. S. Hayden

A temporary stock rack being required that could quickly be assembled, dismantled or moved led to the design of the one shown in the sketch. It is composed of the pipe *A*, the foot *B*, the crosses *C* and the stretchers *D*. All except the pipe are iron castings, and all holes except that in the cross for the setscrews are cast in.

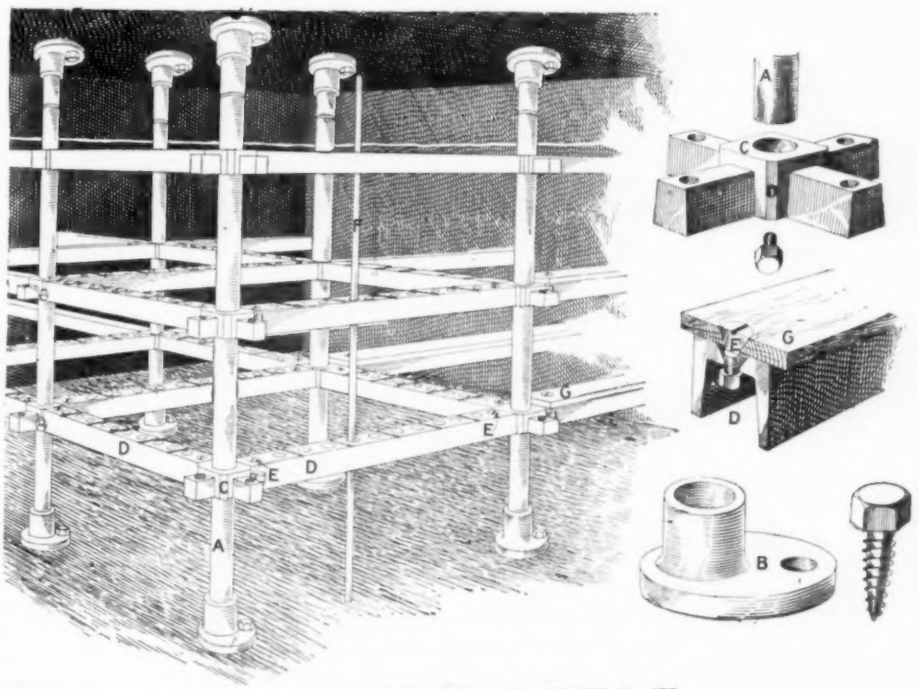
The use of the racks grew beyond the original intention, owing to their adaptability to any space, which led to their being placed in small areas for holding work during the processes of fitting and assembling. A lot of waste 1-in. pipe on hand was probably the main reason for determining the size of the standards.

For a low rack the pipe standards are cut to length, a foot and the requisite number of crosses slipped on each, and the rack is ready for assembling. The stretchers are cast in 18-in. sections with a sharp notch every 3 in. apart, making it possible to break them into multiples of the full length to accommodate even the most limited space. The stretchers are joined to the crosses by small countersunk head screws as at *E*.

When a rack is permanently placed, the feet are lag-screwed to the floor, and if a high rack is needed the pipe standards are cut long enough to reach the ceiling and a foot used on each end.

Where there are quantities of small stock of various diameters to be stored, requiring small bays, these are quickly provided by dropping a rod through the holes in the stretchers at intervals, as shown at *F*.

Where stock such as long bars of steel is stored on end the longitudinal stretchers are left out except for one at the top and one at the bottom, and both ends



A CONVENIENT FORM OF STOCK RACK

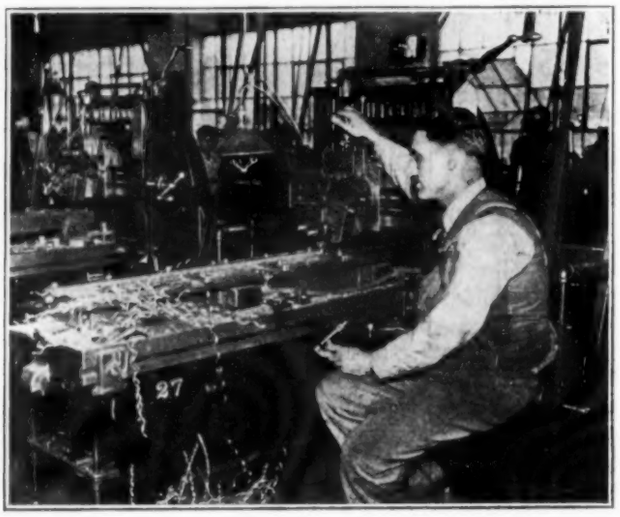
of the standards are secured. Such racks are of course placed next to a wall or other permanent backing, and when stock is put in or removed it is necessary only to lift out the top front stretcher, which is not bolted in. If it is desired to store finished stock or parts on these racks, strips of hard wood are secured to the tops of the stretchers as at *G*.

Although some of the bays of this rack have been at times apparently overloaded there has never been a break of the stretchers or slippage of the crosses, so the ultimate load capacity of the design is not known.

Magnetic Chuck for Holding Broach Blanks

By James McIntyre

Instead of holding broach blanks with clamps when planing, the J. N. Lapointe Co., of New London, Conn., uses magnetic chucks. Broaches made by this company average 40 in. long, and in holding them the old way there was always a tendency to spring. By substituting



USING MAGNETIC CHUCKS ON A PLANING MACHINE

two magnetic chucks of the Heald type, this difficulty was overcome, also this method of holding parts to be planed is much quicker, and the work comes off the machine perfectly straight. Of course a stop must be used for the flank to butt against or it would be pushed off the chuck. Side stops are also necessary to keep the work in proper alignment.

Repair Kink for Worn Connecting-Rod Bushing

By Charles Lindberg

In overhauling internal combusion engines, it will often be found that the connecting-rod bushing is worn but the wristpin is almost true. By pressing the bushing out and knurling it (coarse) on the outside and pressing it back again, the hole will compress itself enough to be fitted over again. If the wristpin is worn a little but not enough to warrant making a new one, then by having it a driving fit, the bushing will move free when it gets to the centre.

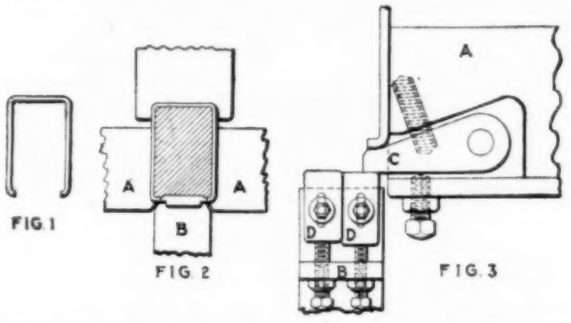
I have used this kink for years and found it satisfactory; saving quite a few pounds of bronze by the method. Of course it doesn't work on steel bushings.

Short Ends in Wire Forming

By S. B. Royal

Difficulty is usually experienced in bending short ends in articles, as shown in Fig. 1, in the wire-forming machine. The reason for this is shown in the tool layout, Fig. 2. As will be seen the side tools *A* must pass a little beyond the side of the wire to give the first bend to the ends. Then if these ends are real short the back tool *B* has no chance of giving them their final bend into place.

A tool, as shown in Fig. 3, should be used if this bend has to be at right angles or less. Its operation is obvious, the side tool *A* carries the swivel jaw *C*



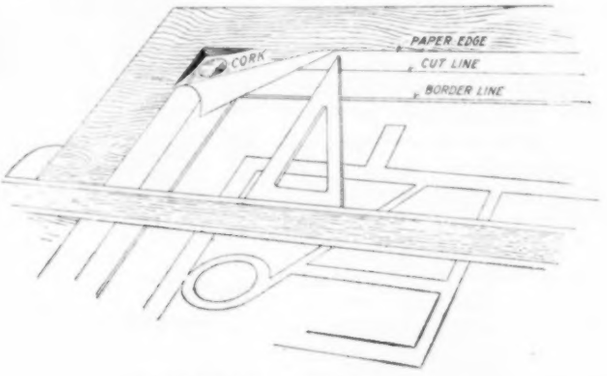
FIGS. 1 TO 3. BENDING SHORT ENDS OF WIRE
Fig. 1—The piece to be bent. Fig. 2—The uusal manner of bending the short ends. Fig. 3—A better method

which is held against the adjusting screw by the spring. When the side tool moves forward the jaw bends the wire as shown by the dotted lines. The back tool *B* has two adjustable pieces *D* which act on the jaws and bend the ends to whatever angle is desired.

Thumb-Tack Kink

By J. J. McIntyre

Raised thumb tacks on the drawing board are a source of annoyance. Where the standard sizes of detail paper and tracing cloth are used the following method of securing the paper has been found advantageous.



FLUSH-HEAD THUMB TACKS

Lay off on the board the points where the thumb tacks enter. From these points a recess is chiseled out, as shown, enough so that the head of the thumb tack is below the surface of the board.

At the point where the thumb tack enters the board, holes are drilled to receive pieces of cork, so that as the holding power of the tacks is diminished new pieces of cork may be inserted.

Advances in Industrial Management*

By JOHN CALDER, M. E.
Director of Modern Production Methods, Business Training Corporation, New York City

THE invitation to address the editorial conference on an industrial topic is much appreciated. No nation is so well served by its business publicists as the United States and in none are they so readily taken into the manufacturer's confidence. The policy of the "open door" to industrial journalists has been of great value to our plants and factories and we are increasingly aware that the only secret therein of any consequence is the open one of ability—of doing it first.

How is that ability now developing? In what direction is it branching out? What contribution is the engineer in industry making toward the common good? I will not dwell upon the material improvements. Progress in appliances, devices and systems is constantly in evidence. Nor will I devote any of your time to consideration of the problems of the worker on the threshold of industry, the apprentice, the vestibule-school and the employment manager, ranging from a mere registry of labor to the full-fledged official overseeing all industrial relations. I will deal rather with progress in studying the reactions of the workman himself to the machine we call industry in which he is vaguely conscious of many things which seem contrary to his interests and aspirations.

In no other country in the world is industrial journalism so warmly received by the business interests as in America and the policy of the "open door" in this respect will be of inestimable value in bringing about and maintaining the condition of understanding and coöperation between employer and employee that is to constitute one of the most important subjects of scientific research in the next decade. Advantage must be taken of every factor that will tend toward social and industrial harmony; misdirected energy and sentimental incompetence eliminated from the study of the problem; schools established to educate the foremen and minor executives coming directly in contact with employees; and every effort put forth to establish the relations existing between the two principal factors of industry upon a sound and democratic basis.

The distinguishing feature of the eighteenth century was the advancement of pure science and of its application to inventions. Yet a greater gain to the world than all the growth of scientific knowledge has been the diffusion of the scientific spirit, with its method of scrupulous verification, with its courage and serenity, its disciplined conscience, its intellectual morality and its habitual response to any disclosure of the truth.

Fifteen years ago the empiricism and rule-of-thumb which characterized to a large extent the manipulation of materials and equipment in the production of wealth were invaded by the deliberate application of the scientific method, hitherto confined largely to the laboratory and designer. Since then standardization, specialization and elimination of waste—features always characteristic of American industry—have gone on apace and have been extended from the material things of industry to the sphere of the worker, in health and disease, in safety and accident, in recreation and education and in all of his economic and civic relations. Not a few lessons on the scale of industry have been learned recently. Large scale production and distribution have been fully recognized as not only economically desirable but also as socially imperative for a nation of 110,000,000 steadily raising its standards of living. Extensive concentration of material resources in able private hands has been fully justified by the results and, whatever the future may hold of controversy as to the division of the wealth created, American labor is in no doubt as to the indispensableness of the ability of management and the necessity for continually attracting and holding it.

Mere bigness of individual plants is now under question. It is felt that they may become too big and that each unit should be restricted to a size well within the capacity of its management to impress itself directly upon the staff and upon the individual worker. Some of our largest plant units today, though wonderful examples of engineering skill and organization, are doubtful ventures from the point of view of successful handling of the human factors. Poor judgment as to the most desirable scale of operations in some of our war-industry ventures resulted in spreading out supervising ability so thin as to cause much inefficiency. We also learned while passing through the discipline of war times that the mere machinery of business may receive from the enthusiastic specialist a meticulous attention out of all proportion to the benefits it can confer, compared with a corresponding amount of effort and understanding directed toward the handling of the human factors.

The spread of theory and practice in the matter of applying the scientific method of accurate observation, verification, analysis and inference to industrial problems has been greatly aided by our trade journals. Yet the mass of our plants is still little influenced, partly owing to the lack of intelligent participation by owners and in the larger degree to the fact that many promising proposals have been presented to industry by specialists in terms which greatly exceeded the intelligence of those who must ultimately carry them out. Here we have demonstrated again and again that we never really *know* anything which we cannot *do*. Now in the aftermath of the war, with the urgency of demand temporarily removed, with many consumers on the fence, certain labor problems only temporized with during the strife are coming up for settlement and many questions call for answers.

Shall we courageously apply the scientific method? Shall we view them in the light of the truth, the whole truth, and nothing but the truth about all the people and things concerned in industry? Have we any policy in the premises? Have we any considered program to meet them? Can industry now resume its normal course? Can the "economic urge," removed in so many cases by war policy, be imposed once more upon employer and employee alike? Can our Government be now content to regulate, not to control or operate business? Can the complicated phenomena vaguely termed "labor troubles" be taken out of politics? Can they be faced and solved in man-to-man fashion in each of our plants? And can the scientific method be applied to men and human instincts in industry as successfully as it has been to things?

To all of these questions we believe the answer is in the affirmative. Across the Atlantic organization of labor and of capital is already so complete and is represented by such high intelligence that what is practically an industrial parliament has been sitting for weeks in London and has just announced unanimity of opinion as to how eleven million of workers and thousands of employers shall live and work together hereafter. It is a great event without the slightest implication of revolution about it and is worthy of the best traditions of the English people. Political sanction cannot be much delayed with such a clear mandate from all classes of industrial and social thought.

*An address before the Industrial Conference of the New York Business Publishers Association, April 11, 1919.

But *we* have no immediate prospect of any such solution nor have we any such situation as characterized the war-weary, working people of Great Britain, who have surrendered for several years hard-won and long-cherished rights to the exigencies of the great conflict. Our industrial unrest, such as it is—and it has been somewhat exaggerated—requires an American solution which, we believe, will not come from the White House or any state house. Forty-eight sovereign states rightly jealous of their constitutional privileges make any such present solution as that proposed in Great Britain impossible, but the details of that solution are bound to modify our thought on social possibilities.

Here we must act in the spirit of that Chinese proverb: "If you want to keep the town clean, let every man sweep before his own door." It was this spirit, in which the Steel Corporation took a commendable lead, which put safety engineering on the map in our plants and socialized the idea—not statutes and inspectors; and it is the same spirit of liberal initiative which is opening the way for closer relations between capital and labor; relations which must necessarily at first be local and particular to each industry and plant until organized labor is as truly representative as it is abroad. But organized to amicable ends these relations must finally be and they will always prove most satisfactory where the highest intelligence is actively representing both.

Better Understanding of the Worker

Our chief gain recently in management has been a better understanding of the worker, his fears, ambitions, attitudes and achievements. Most scientific studies of industry have dealt essentially with purely mechanical elements, the employees being regarded chiefly as so many hands available at all times, as a matter of course, to carry out the will and intention of the inventor, designer and business planner on schemes for using them effectively; schemes sometimes quite meritorious but with no provision for obtaining the consent of the governed.

About these schemes the workmen were expected to have no opinions at all. It was assumed that at all times they would respond to a large money inducement alone and there was both surprise and chagrin when opposition was encountered in which earnings were not involved in any way, and even where no open resistance was offered high earnings were not always accompanied by satisfaction on the part of the worker. Yet economic friction is to be expected. It is an inevitable factor in democratic industry. Wherever men think, they will differ in opinion and reconcilement can never be forced. Vaguely and unsatisfactorily termed "labor trouble," economic friction is really the growing pains of industry and there is a close connection between it and the inherent tendencies we call human nature.

The strongest of these tendencies is curiosity and the outstanding fact that the industrialist must keep constantly in view is that *the workman instinctively suspects everything he does not understand.* What a vast number of things there are in which we leave him to find an incompetent or prejudiced tutor! The workman wants to know why things happen, how they happen, how his work can be adjusted to his circumstances, how these circumstances can be reconciled with the claims and keenly felt limitations of his personality, and how he can, with least effort, attain the results he aspires to. So what we have to concentrate upon in the near future is not the extension of mechanical facilities—that is going on almost automatically, forced indeed by the growing needs of peoples. We have to ask ourselves, Can people in industry be educated for freedom and individual self-expression? Or, are we still to consider, as has been done, that huge group enterprises should educate for and aim at a quite docile organization of human units? The answer undoubtedly is that the self-assertion and self-direction increasingly vocal and operative in workers make the latter course impossible and that all policies leaning in that direction will be barren and futile.

If we fearlessly take the open road we will find that thinking will lead the workman into much truth at present hidden from him. He takes much boldly proclaimed error on trust. He has no chance to examine it competently and the truth about many things is not spoken or written in language he can understand. Thought, we must remember, requires leisure; it needs vitality and it must have energy and clear social purpose in view and be pursued as a habit and through method. The tired, the lazy, the indifferent, the ignorant work people cannot or will not organize their thought. Yet in a true existence the elements of plan and will and intention must enter in and modern business changes now impending and involving industrial democracy are simply due to the strong conviction that a place *must* be found for human personality, that we must somehow, in spite of large scale efforts, come back to "folks."

To put it in a single phrase the desirable, social and economic program for us is simply this, "to make goods plentiful and men dear." There are people engaged today in stressing one or the other of these things, but there is no satisfactory economic future for any of us without both. To attain it we must embark on a program of education distinct from and supplementary to the many forms of mutual interest now in action.

We now know that human engineering, tackled in spots only, such as safety, welfare and employment, has been, as a whole, neglected in industry where it counts most. We have discovered that human conduct tends to become more intelligible and also more responsive to the control necessary in industry, the more we view it in the light of our understanding of the primary motives of human action. Not all of our failures in industrial relations have been due to poor handling of men, but wherever they have been, we have found an unconscious but not less real repression of the employee and his aspirations. If these are now liberated and wisely guided there is no telling what we may accomplish.

Motives Misunderstood

We also find misunderstanding of the motives of employees and we see sentimental incompetence busy dealing out what it calls social justice without any close knowledge of the facts. This has merely confused things. Plans for obtaining the fullest democracy in industry for self-expression and self-determination are under way, but these should not crystallize in programs for giving the workman what he does not want or what he is not entitled to. Backing these up by statute or administrative order settles nothing in the end. Only through enlightened and energized employers and their foremen in industry will a permanent advance be made. The foreman's education has been sadly neglected and yet he is the man, and the only man in authority, who makes contact with our workmen through a half of their waking hours. To apply the scientific method to the people in industry as well as to things is the problem of the third decade of the twentieth century—a problem of wonderful possibilities. Not only must we cultivate more intensively in every plant and industry the modern production methods now highly elaborated, but we must set about to greatly enlarge the intelligence of those who must carry out these methods, namely, the non-commissioned officers of industry, the foremen. This is of great importance. No ideas are of much lasting benefit in any plant unless they are well sold to the foremen and only a mere fraction of the present-day literature on how to analyze and handle the human factors in industry is intelligible to the foreman who must do this work in detail. Without simplification and interpretation and personal contacts these men who were selected essentially for technical proficiency will never become adepts at making men as well as at making things and we may be certain that enlightenment which does not reach the foreman will never reach the workman.

Begun in the closing months of the war courses of instruction for foremen and heads of departments now cover several thousand men grouped together chiefly in numerous private corporation classes. This instruction is necessarily different from that offered to adolescents or to men lacking in experience in industry. The classes embrace men from 25 to 65 years of age; men of responsibility who have ceased to study but who are ready to respond to texts specially prepared for them, combined with lectures and open discussions on their problems. The

courses are on the Plattsburg method, covering only three months, for that is the limit of efficient attention and interest at any one time of groups of this character.

Liberal, forward-looking ownership and management inviting self-expression and self-determination on the part of the labor in its plants is everywhere handicapped today by the unenergized and unenlightened foremen and minor executives who make the intimate contacts with the workmen.

Individual organizations sincerely aiming at democracy in their industrial relations must insure that their foremen are instructed and willing coöperators, and the particular technical competence for which they were originally selected is no guarantee of this. The number of things which are simply taken for granted about the man once he is ranked as a foreman is surprising, particularly in relation to knowledge and analysis of himself and of the human factors in his daily work.

In this latest and far-reaching movement in industrial management to raise the standard of executive intelligence and sympathy it is the uniform experience that no foreman or assistant is too young or too old to benefit greatly from a renewed intellectual interest in his task and in the people he has to handle, and it is found that the essential elements of the educational and inspirational program necessary are equally applicable to men in responsibility in every kind of industry.

Sending the foreman back to school at the expense of the employer is a new idea to most owners, who have been willing to spend money on many other things much less worth while. But if that school is held in the employer's own plant, aims at a definite objective and makes a family party of the occasion, it is found to be a most fruitful source of enlightenment and enhanced good will. Such a meeting has nothing in it of a business gathering with a sense that the executives are being worked over time. It is taken up with consideration of self-analysis, team work, organization, plants and their requirement, the records of industry, and the management, direction and control of the working force as an efficient team. On all of these we find the foremen in industry of every kind eager for information and participating willingly in the discussions.

The art of management and supervision has been well worked out to date, so far as the chief executives are concerned, and it calls for an ever increasing and high order of ability. It has sometimes been inclined to belittle the foreman and at other times to ignore him. Yet we have a fair supply of good managers today and are calling loudly not for them or for advisory engineers but for competent foremen, not merely to criticise, but to supervise successfully and to "deliver the goods" with the only kind of help now available, at a cost that makes good business and with due regard to the aspirations and interests of labor.

It is to discover this man in each plant, to develop him where known, to create an interest in his job and to retain that interest, both in it and in his employees, that this educational movement has been specially prepared and offered as something new and necessary at this epoch in our industrial history.

This teaching which the Business Training Corporation of New York has instituted for all kinds of plant executives under the supervision of experienced managers, is an absolutely necessary preliminary to success in the introduction of industrial democracy, which depends as much upon atmosphere and education as upon conferences and rules of procedure.

Worms and Worm Gears*

By G. W. CARLSON
Timken-Detroit Axle Co.

The author of this article tells of the application of worms and worm gears to automotive construction. The two forms of worms—the straight and the hour-glass form—are discussed and the points of each are touched upon. The application of this form of gearing is also suggested for other purposes than automotive drives.

THOUGH the principle of worm gearing has been known for centuries, it is not until recent times that it has been employed as a form of power transmission in the full sense of the word. It was confined to such uses that called for a great reduction of motion rather than transmission of power, and even until late years it was not resorted to except for electric elevators, winches, etc. It was commonly assumed that it should be of high reduction and irreversible. The efficiency was of necessity extremely low—often less than 40 per cent.—and therefore not an economic power transmission. The developments later toward the involute form of tooth, and lower reductions proportionate to the pitch and centers, have brought the worm gear to a state of mechanical efficiency where it competes successfully with the spur and bevel gear.

It is not the writer's intention, however, to recount the ancient and modern history of the worm gear, nor try to encompass the subject as related to its many and varied forms and uses, but rather to, so far as is consistent, keep within the confines of his past experience with this form of power transmission. This involves, therefore, that particular application of the worm gear which has, perhaps, more than any other agency, contributed toward its popularity and rapid development in recent years, namely, worm-gear axles. There is no one who can but acknowledge the success of the worm gear in this field. Its use here has become almost a necessity and, though the widely accepted supposition of its inefficiency brought on a siege of skepticism and criticism, it is today firmly established as a final drive for motor trucks.

It is true, that among axle builders at least, the worm gear—before the development of helical bevels—began to be recognized as the eventual successor to the bevel gear in passenger cars. This was mainly because of the difficulty encountered in producing gears that would pass the silence test. As the truck operator, and everyone in general connected with trucks, began to lose patience because of the everlasting noise of the chains, and the nuisance of frequent replacements, so did the passenger-car buyers begin to demand quieter gears in their cars. Many car builders had already installed worm gears, or contemplated so doing, when the helical bevels were introduced. These have since that time, at least in the United States, had a clear field except in the case of passenger electrics. It seems, therefore, reasonable to assume that, but for the introduction of the helical bevels, the worm gear would today enjoy a considerable popularity as a passenger-car unit. The

* Presented at annual convention of American Gear Manufacturers Association, Cleveland, Ohio, April 15, 1919.

low-gear reductions, then in use, for the time being at least, eliminated the worm gear as a competitor in this field. It is a question in the writer's mind, however, whether in this connection it will not again attract the attention of the automobile designer. The present tendency is decidedly toward higher-speed engines. The ratios are consequently increasing and with the present state of bevel-gear development, the limit in reduction requirements available in them is rapidly being approached. The change to smaller pitches is out of the question in face of the incessant cry for more power and more road clearance, and there does not seem to be any design yet in sight radical enough to permit of lighter-weight cars proportionally to the power. The above statements are made, leaving out of consideration such experiments as have been tried with high-ratio gears and coarse pitches, and which ostensibly meet the requirements, but, to the writer's knowledge, they have not yet reached a point where success or failure is assured.

As in any form of gearing, the worm gear in its present state undoubtedly leaves a great deal to be desired and ample room for further development. The high mechanical efficiency and the smooth and silent running are attributes of it which should form an encouraging basis for such development and research.

Two Types of Worm Gears

Fundamentally, there are but two types of worm and gear, though the principle involves a multitude of variations of minor detail. They are the straight or parallel and the hour-glass or, as it is commonly called, the Hindley. The relative merits of these two types have been the subject of many discussions. The parallel type is the oldest in practice, though the hour-glass type appears to have been the first introduced in motor vehicles. The former is today the one most used, nevertheless, in automotive-power transmission.

The straight, or parallel, type of worm is by far the easier of the two to produce, which fact has perhaps been indirectly the reason for its comparatively wide use, and made it the object of much study and many improvements in method of manufacture and mounting. It eliminates at least one adjustment which is now inseparable from the hour-glass type where there is wear on the worm thrust bearing. As this wear takes place the worm will travel in a fore-and-aft direction, in which case the hour-glass worm will eventually destroy itself, or if it is originally incorrectly aligned fore and aft. Assuming the merits of the two being equal, accuracy possible in manufacture is decidedly in favor of the parallel worm, particularly due to the fact that it can be ground after hardening. This is important, as distortion is attendant to any complicated form like a worm in hardening, and cannot be easily corrected by buffing. In fact, it is more the rule than the exception that where much buffing is required the irregularities in the worm threads are accentuated and the threads will vary in thickness. This will destroy smoothness of action, produce a hammering on the gear, and often cause considerable noise. An irregular surface of the threads will also cause the teeth of the gear to pit, and frequently this may be so great as to ruin the gear sometimes before it has had a chance to properly "wear in."

The principal aim in the modern worm gear is to reduce the rubbing action to a minimum and to increase the rolling action to a maximum; in other words, the main consideration in bevel or spur-gear design.

It is a common error to assume that in all worm gears the tooth action is mostly a rubbing action. It is a combination of rolling and rubbing. Recent developments in the parallel type have been productive of remarkable results in this direction. The actual rubbing velocity has been reduced to so much below that usually calculated that the motion is transmitted by a rolling action far in excess of the rubbing action.

The Worm Gear Has Its Limitations

The worm gear, like the bevel, so far as concerns current axle design, has its limitations as regards reduction. Though an excessively high ratio may be employed, the efficiency is reduced proportionately, due to the decreased lead angle, assuming, of course, that the center distance is constant. If the centers may be increased so that the lead angle remains constant, then the efficiency will not be appreciably affected. It decreases rapidly when the lead angle is less than twenty degrees; in other words, at the point where the rubbing action begins to rapidly increase proportionately to the rolling action. Developments have demonstrated that in order to maintain in all reduction a maximum efficiency, the lead angle must remain within a given limit. A considerable change in ratio, therefore, makes a corresponding change in centers or pitch necessary, which latter conditions would seem a check to the capacity due to tooth stresses set up by the use of a necessarily smaller pitch. In axle requirements, however, the reductions come so well within these limitations that for all purposes the efficiency may be assumed as constant.

The Efficiency of a Worm Gear

Many arguments have been advanced against the use of worm gears in axles from a standpoint of coasting qualities of the car. In speaking of the efficiency of a worm gear it is usually assumed that the power is delivered through the worm into the gear. It is true that where these conditions are reversed, as in coasting, the efficiency would be lower for the same power applied and where the lead angle is less than 45 deg., in which case the efficiency is the same. It will be seen, therefore, that because of this fact, the greater the rolling action of the tooth the less the effect will be on the efficiency when the power is reversed. It must be borne in mind, at the same time, that the lead angles in axle gears come fairly within the range where the reversing action has little effect upon the efficiency, also that in coasting the resistance of the worm is limited to that of turning the transmission gears, except when it is desired to use the engine as a brake, in which case the reduced efficiency is an added advantage.

In the gear adopted for axles, such as the David-Brown type, the allowable variation in pitch for constant load is considerable because of the tooth form peculiar to it. It is such that the load produces very little stress. A line drawn from the pitch line and at right angles to the pressure angle and through the tooth, will pass by the base of the tooth at the opposite face. It is obvious that under these conditions the tooth will not easily break, which experience has proved, and even a foreign object passing through the gear will not strip a tooth but rather break the gear in two.

The same obtains also in cases of overload. When the tooth pressures are too high the gear teeth will not,

as a rule, strip though the life of the gear will be reduced in proportion to the overload. The writer has personally observed cases where the worm and gear had been mismated, that is, a worm intended for one ratio and a gear for another, one of which had been in service approximately six months before the error was discovered. This remarkable showing was undoubtedly due to the grade of material in the gear. The teeth had actually assumed a contour conforming to the worm thread for the actual working depth, which was slightly in excess of ¼ in. The lead angles differed originally by approximately two degrees, but at the time the gear was examined the teeth had assumed the same lead angle as that of the worm, at the contact between them. The material commonly used in axle worm gears is a bronze generally 89 per cent. copper and 11 per cent. tin. This combination seems to give the best all-around result in that it presents a contact surface of great durability and a low coefficient of friction. The castings are chilled around the outside face. The hardness of the chilled portions is usually maintained at about 90 to 100 Brinell. The chilling has a number of advantages. It has a refining effect on the grain of the metal and prevents segregation of the tin from the copper, which is often the case in sand-cast gears. It also produces a much cleaner casting, which, because of the absence of sand pockets, greatly adds to the life of the machining tools and makes it generally a much better machining proposition. It has been found practicable in not a few cases to dispense with the operation of rough hobbing without in any way affecting the quality of the finished gear or decreasing production. There have been endless experiments made with other materials, but to date there does not seem to have been any generally accepted as having proved suitable to every form of duty, though in individual cases and under limited conditions some have proved satisfactory.

The strength of a modern axle worm gear, as has been stated before, is because of the tooth contour, more limited by the tooth backing than by the strength of the teeth proper. The current method in axles is to bolt the gear to the differential. It has often resulted in the gear breaking—actually pulling apart between the bolts. To prevent this, it has been necessary to make the gear extremely heavy, thereby incurring a considerable expense. An old design whereby the gear is made to mount on the differential and held by a number of small serrations, has been made use of with marked success. The improvement of this over the present method lies in the fact that the resistance to the rotating tendency of the gear is taken directly under the point of application of the load or, progressively, under each tooth at the moment of load application. It will be seen that since the metal, where this construction is used, cannot, except through inaccuracies of machining, be stressed beyond the load-carrying tooth, the gear itself may be made considerably lighter, thereby effecting a material saving of expensive bronze. An effort toward attaining this end, but by a different method, is made by a well-known tractor manufacturer. In this instance, the teeth are cast in the gear, allowing only a slight amount of metal for machining. The worm is usually made of an alloy steel carbonized and hardened to a scleroscope reading of 80 to 90. Though a good polish on the threads is desirable, it seems more essential to have an accurate contour of the wearing surfaces. As previously stated, a high polish can often be procured only at the expense of accuracy. It is therefore sometimes the practice to grind the threads twice. The first grinding is made for the purpose of removing the irregularities due to the hardening. The second grinding is made for the purpose of producing a smooth surface in order to reduce the polishing process to a minimum. This has an added advantage, inasmuch as it prevents the operator from taking off too much stock at one grinding which has a tendency to produce minute surface cracks.

The life of a worm gear embodying the characteristics as outlined is truly remarkable. This does not mean wearing out from any cause (because many gears have been ruined for lack of lubricant and other misuses), but for any defect inherent in the type or principle.

The efficiency of a worm gear is theoretically very high when properly designed. Among the great number of variables upon which the efficiency depends, the lead angle is the most important. Contrary to statements sometimes made, the small diameter worm gives the best results even though the angle may be great. The only feature militating against it is the question of deflection under load. A number of cases have been observed where the worm, however, has been subjected to a calculated deflection of 0.002 in. to 0.003 in. under continuous service without any apparent injuries resulting.

The fact that we have achieved so much and still know so little about this form of gearing should make it a doubly interesting field for exploration. It is not any longer a transmission of motion to be used, but an actual, highly efficient, and silent power transmission, taking its place beside the spur and the bevel.

∴ EDITORIAL ∴

Paying for Victory

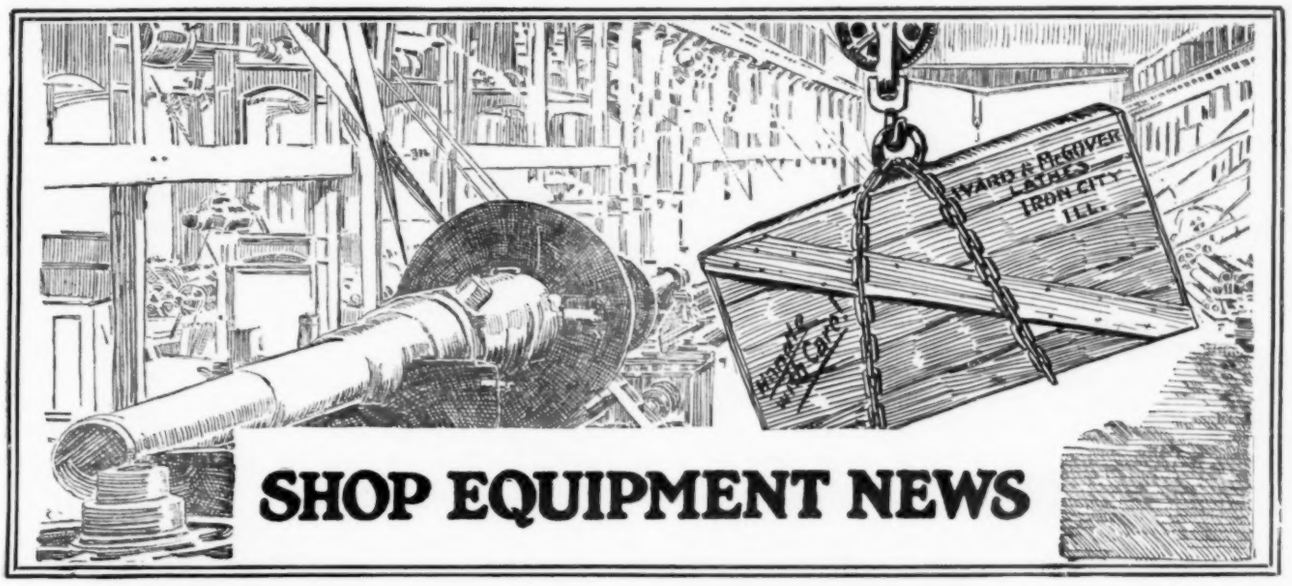
THIS week ushers in the launching of the Victory Loan—not a Liberty Loan this time but something far better. It is an announcement, a reminder and an appeal to our readers to live up to their responsibilities. We are mailing with this issue a colored supplement typifying the Goddess of Liberty appealing to each one of us from the grave-dotted fields of Flanders.

□ □ □

Hundreds of thousands of men have died in order that we might live to see victory come to pass. They have esteemed it a privilege to be able to die for this victory. The little part that we are asked to do is to pay the money cost of victory. *They* have paid the blood cost.

□ □ □

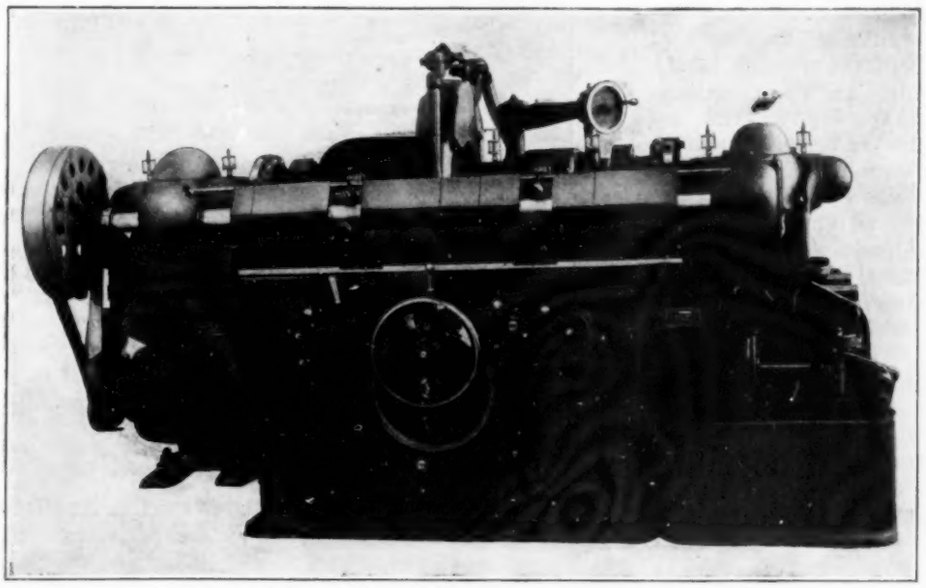
Knowing this, can anyone who has a heart or a mind or a soul fail to take up his little share of this burden?



SHOP EQUIPMENT NEWS

Landis Self-Contained Crankshaft Grinding Machine

The Landis Tool Co., Waynesboro, Penn., has just placed on the market the new type of self-contained crankshaft grinding machine shown in the illustration which is built for accurate crankpin grinding on airplane, automobile and other gas-engine crankshafts. No offset centers are required, the work being held in adjustable holders located at both ends. The work is driven from both ends, the two crankheads being geared together while the different throws are obtained by means of a sliding adjustment of the crank carrying fixtures which are mounted on the ends of the crankhead spindles. This adjustment is of the micrometer type and is operated by a screw having a graduated dial. For multiple-throw crankshafts in which two or more pins must be ground in exact relation with one another, one of the carrying fixtures is provided with a gaging block, made to suit the throw-angles of the crankshaft. If desired, the crank-carrying fixtures can be equipped with a swiveling index, instead of the standard gaging block, this swivel being graduated to give all of the regular throw-angles. Also if desired, fixed throw-heads can be furnished instead of the adjustable heads for use in the manufacture of a large number of crankshafts of the same throw. Alignment of the crank-carrying fixtures is secured by the adjustment of two screws carried in the hub of the bevel gear, mounted on the spindle in each head. A second function of these screws being to hold the gear in positive relation to the shaft, this construction takes the place of the key customarily used. These screws are accessible when the crankhead covers are removed. A special feature of the machine is the method of mounting the counterweights which are fastened to each side of the spindle gear between the spindle bearings. It is claimed that this construction reduces the overhang of the spindle to a minimum and places the counterweights for the work in such a position that they will not influence the end of the spindle The crankhead spindles are large in diameter and are provided with long phosphor-bronze bearings which are adjustable for wear. The spindle gear is mounted on a tapered portion of the spindle between the spindle bearings, this arrangement permitting the mounting of the work-carrying fixtures directly on the end of the spindle and close to the bearing. The main drive shaft operates the crankheads through a steel sleeve carried in each head, this sleeve carrying the gear that meshes with the large spindle gear. The driving shaft and the sleeves are fitted together with taper keys, these being loosened by a screw adjustment when it is desired to slide the heads along



LANDIS CRANKSHAFT GRINDING MACHINE

the shaft to adjust for different lengths of work. After adjustment the keys are again tightened by the screw adjustment to prevent any possibility of play between the shaft and the sleeve. These taper keys can also be used for securing a fine adjustment on aligning the two crankheads.

The driving sleeve is mounted in bronze bearings, one at each end of the sleeve and the driving gear is mounted on a taper between the two. The gear is held on the taper by a nut on the sleeve, the gear being fitted like the spindle gears with adjusting screws instead of a key for the positive location of the gear on the driving sleeve. The gears in the crankheads run in an oil bath to insure proper lubrication.

The work table swivels for grinding tapers and the changes of work speed are made by shifting a belt on cone pulleys by the movement of a single lever. The wheel head is mounted to slide on V- and flat-ways, the spindle being made of special steel, running in bronze bearings adjustable for wear. The driving belt is kept under uniform tension by an automatic tightener which also serves to take up the stretch of the belt. The feed of the wheel to the work is either by hand or automatic, it being possible to set the automatic feed to reduce the diameter of the work from 0.00025 in. to 0.007 in. at each reversal of the wheel carriage. This automatic feed is only furnished when specified, hand-feed being regular equipment. A spacing-bar arrangement for locating the wheel to suit the various crankpin locations can be supplied if desired. This device is a great time saver when large quantities of duplicate shafts are to be ground, and where there are several types of crankshaft to be handled, the machine can be equipped with spacing bars to suit each type as the bars may be changed quickly to suit the work in hand.

A lever is provided for connecting and disconnecting the carriage traverse and when the spacing-bar arrangement is included, this lever has the additional function of engaging the plunger in the spacing-bar slots. A device is also incorporated that prevents the spacing bar and power-wheel traverse to be engaged at the same time. Whether or not equipped with a spacing bar, the machine is provided with a safety device for preventing the power traverse being suddenly thrown in, thus causing the side of the wheel to ram into the crankweb.

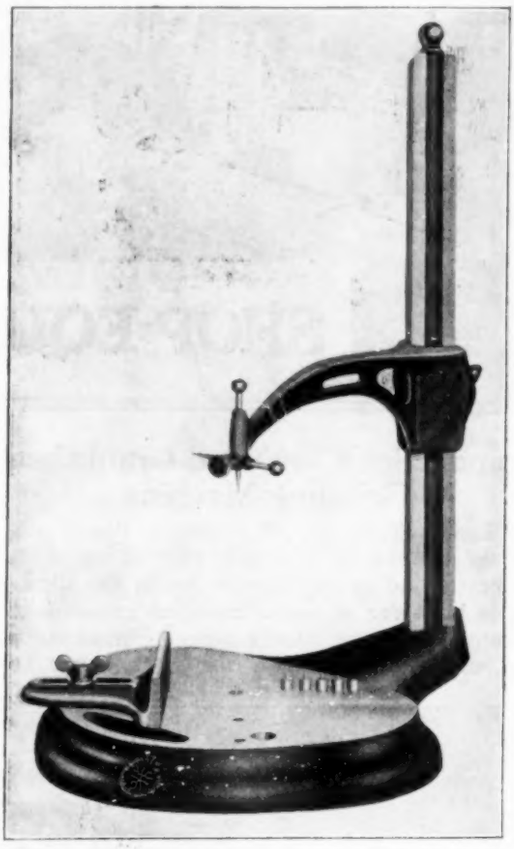
Wheel-truing fixtures are regularly furnished and are used for truing either the face or the sides of the wheel. A radius wheel-truing fixture, suited for truing the face of the wheel and also for forming the corners to an exact radius for grinding fillets up to ½-in. radius can also be provided on special order.

Rests support the work at two points, in front and beneath, these being independently adjustable. The support adjusting screws have stops which can be set to limit the movement of the rest jaws.

The lubricant pump is of the centrifugal type, so arranged that the lubricant does not come in contact with the bearings. The rotor of the pump is immersed at all times and no priming is necessary.

Syracuse Precision Centering Gage

The precision centering gage illustrated is the product of the Syracuse Sander Manufacturing Co., Inc., Syracuse, N. Y., and is intended for the use of pattern-makers in locating centers and lines on plain or irregular surfaces, opposite the centers and lines obtained when work is laid out as on the cope or parting of pattern. In use, a centering point is pressed into the center on the pattern which is then placed on the base. This centering point fits in a hole in the base and the scribe in the arm is in alignment with the center of this hole, so that when the arm is lowered a center is marked on the upper side of the pattern directly opposite the one on the lower side, this method being said to obtain accuracy and great saving of time. By placing the scribe horizontally in the arm the device may also be used as a surface gage on small patterns.

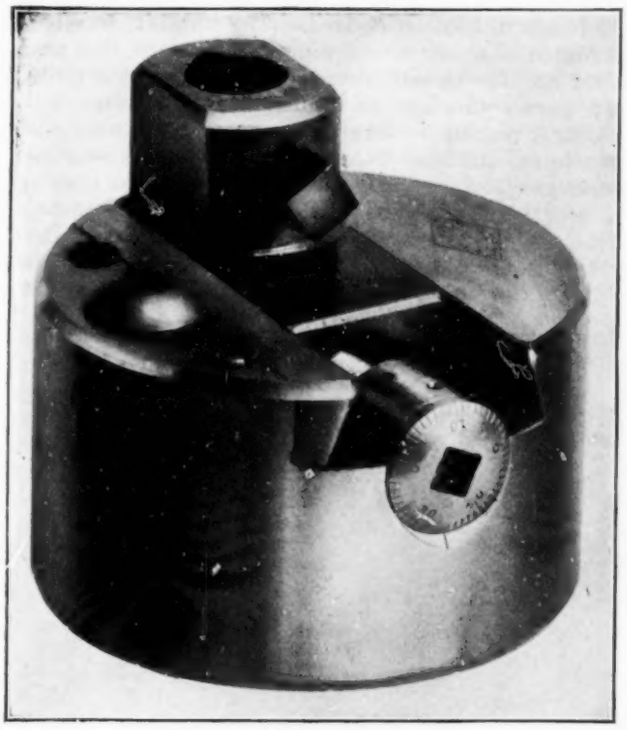


PRECISION CENTERING GAGE FOR PATTERN WORK

Over-all height, 16 in.; weight, 7 lb.; vertical capacity, 12 in.; distance from center hole in base to column, 6 in.; centering points furnished, 6.

Detroit Offset Boring Head

The accompanying illustration shows the Detroit offset boring head. The body of the chuck is made from solid steel 4 in. in diameter and 2½ in. long. The over-all length of the tool is 3½ in. The toolholder is made from 20- to 30-point carbon steel, carbonized and hardened with the bearing surface all carefully ground. The lead-screw nut is machine steel, pressed and pinned in place, and then tapped true with the ways of the toolholder. The lead screw is $\frac{9}{16}$ in. in diameter and threaded 20 threads per inch, and graduated on the head end to show a movement of 0.001 in. The head of the screw has a $\frac{5}{16}$ in. square broached hole for the wrench. The toolholder has a ¾-in. hole with 90-degree angle V. This holder will hold any round stock from $\frac{5}{16}$ in. to ¾ in., and square or hexagon stock from ¼ in. to ½ in. Clamping of the tool is obtained by means of ⅜ in.—16 x 1 in. tool-steel setscrews. The gib is carefully machined and

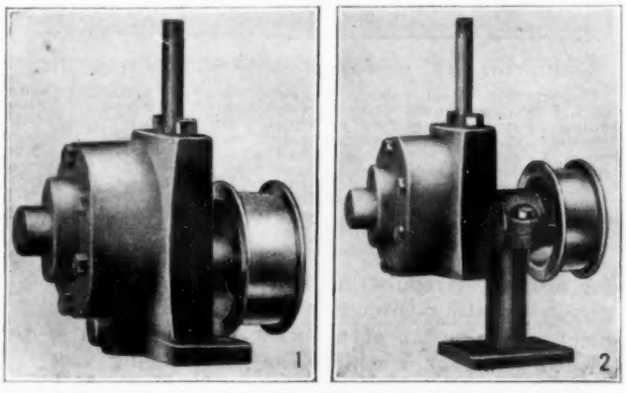


DETROIT OFFSET BORING HEAD

fitted and is held in place by means of two ¼ in. — 20 fillister-head screws. The locking screw is of machine steel, cyanided. The slide has a travel of a little over 2 in., enabling the operator to bore any size hole up to 4 in. Parts are machined in jigs to insure interchangeability of the parts. The head is primarily designed for use on a milling machine but it can be used to advantage on almost any kind of a screw machine, lathe, or drilling machine. The back of the body is bored to fit a No. 4 Morse taper shank. This tool is made by the Detroit Pattern Works, and distributed by the Great Lakes Sales Co., 924 Dime Bank Building, Detroit, Mich.

Matson Gear Pumps

The Matson Machine Co., 2 Beacon St., Concord, N. H., has recently added two new types of pumps to its previous line. Fig. 1 shows the style X pump which is a one-way machine built for ¼- or ⅜-in. pipe. It is intended for use on machines that run reversed part of the time and is equipped with valves that cause the liquid to flow in one direction regardless of the direction in which the machine is running. The pump is complete in itself and needs no check valve if placed within 3 ft. of the level of the liquid being pumped.

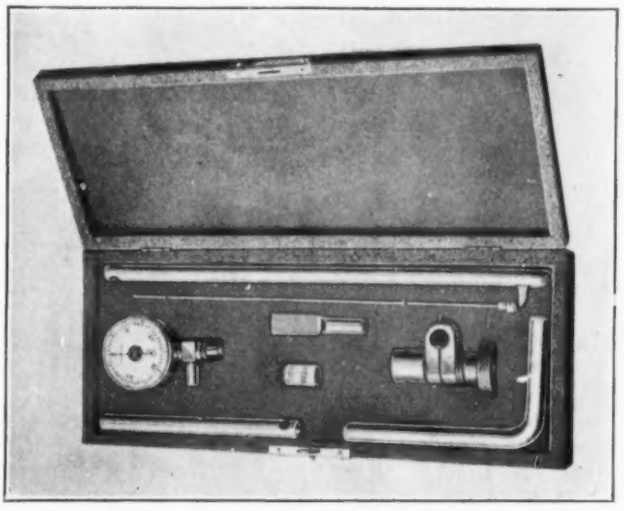


FIGS. 1 AND 2. MATSON STYLE X AND Y PUMPS

Fig. 2 shows the style Y pump, which is of the same construction as the style X, except that it has an adjustable base that can be set to suit any angle, this construction allowing the base to be fastened to a surface at any angle and still have the body of the pump upright. The pump is built in ¼- and ⅜-in. pipe sizes, and the holes in the base can be placed according to the requirements of customers.

Cornell Dial Test Indicator

The dial test indicator illustrated is being manufactured by the Cornell Tool Co., Detroit, Mich., and marketed by the F. Conley Co., 502 Book Building, Detroit, Mich. The instrument is made in two sizes,



CORNELL DIAL TEST INDICATOR AND ATTACHMENTS

No. 1 for toolroom use and No. 2 for use in production work. A number of attachments are furnished with the indicator which is said to be very simple in construction having only 16 parts including screws in its mechanism. The feature of the indicator is that the dial works on a universal joint in such a manner as to enable the operator to always have the dial facing him, thus eliminating the use of a mirror. A number of attachments are furnished, one enabling the dial to be used as a height gage, another indicating the bores of holes down to ⅜ in. in diameter and to a depth of 8 in. A feature is that the indications on the dial are wide apart, enabling accurate readings to be taken. The No. 1 machine will indicate distances up to 0.135 in., while the No. 2 will indicate up to 0.235 in.

Helios Marking Tool

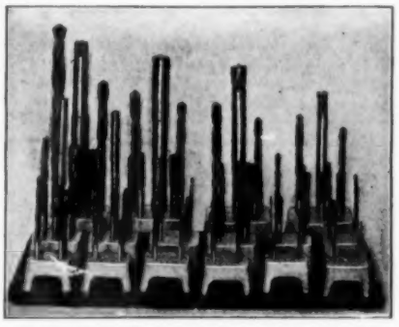
The Helios Metal Co., Inc., 437 Eleventh Ave., New York, is now marketing the numbering and lettering tool shown in the illustration. Instead of having an individual tool for each number or letter, small wheels carrying stamps, numbers or letters are made up, these being held in a holder as shown. One side of the wheel is stamped to show the number or letter on the corresponding projection, while the other side carries a number of impressions into which a locating pin drops, operated by the spring shown on the print. While hold-

HELIOS MARKING TOOL

ing the tool by the sides, the wheel can be easily turned so that the desired figure is ready for use, and while stamping, the spring is pinched between the fingers, holding the wheel rigidly in the desired position. The tool is put up in a set containing one holder and four wheels, one wheel carrying the numbers 0 to 9, while the other three carry a set of letters.

Waterston Time-Saving Tap and Drill Stand

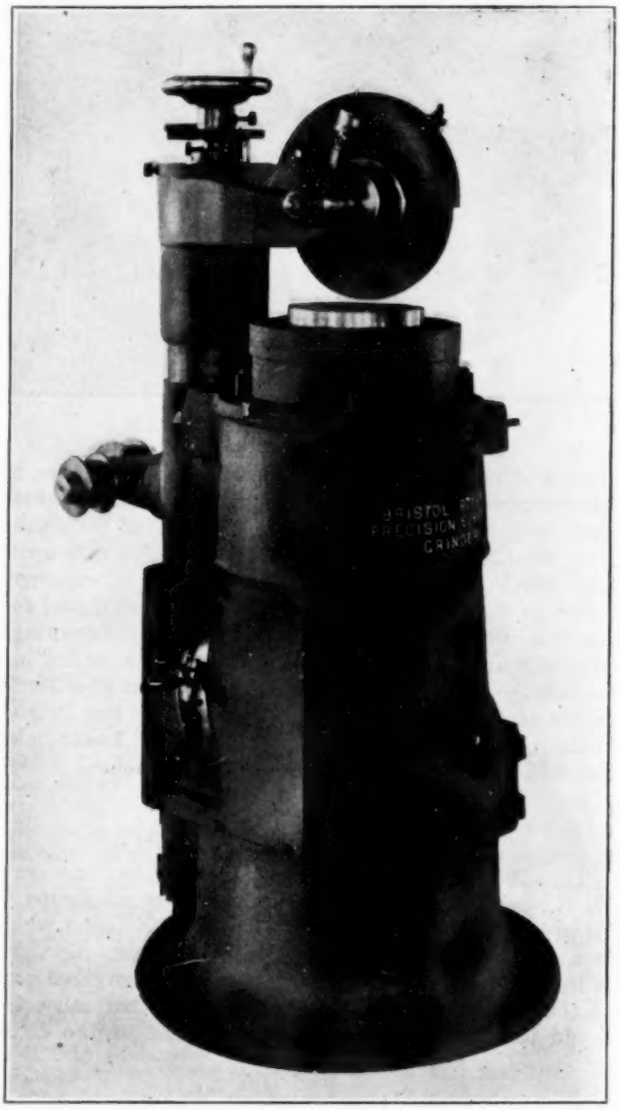
The ilustration shows a stand for taps and drills known as the Waterston Time-Saving Stand, and intended to aid the stockkeeper in picking out the proper size of drill or tap. Each stand holding up to and including $\frac{3}{16}$—24 taps has openings of the proper size to accommodate the body, drill, tap drill and two taps; the stands from $\frac{1}{4}$—20 to $\frac{3}{8}$—11 have openings for the body drill, counterbore, tap drill, and taper, plug and bottoming taps. The stands are made in 16 sizes with wooden tray to hold the whole set. They are marketed by J. M. Waterston, 77 Woodward Ave., Detroit Mich.



WATERSTON TIME-SAVING STAND

Bristol Piston-Ring Grinding Machine

The grinding machine shown in the illustration is made particularly for grinding piston rings up to 8 in. in diameter, and is the latest product of the Bristol Machine Tool Co., Bristol, Conn. The spindle is mounted in adjustable bronze taper bearings held in self-aligning boxes securely clamped to the head by removable caps. This method of construction facilitates the quick removal of the spindle for the wheel replacement. The oiling is by means of two sight-feed oilers. The head is supported and operated through the back column and the wheel oscillates from the center of the magnetic chuck to the left edge. The back column receives its movement through an arm attached to the base of the column, and the head is secured to the top of the column by a taper bushing and clamp nut directly under the ratchet wheel. Loosening this nut enables the head to be swung to any position over the chuck, but this should, of course, be securely tightened when work is being done. A suitable apron is provided on the head to protect the column bearings from grit or dirt. The feed may be by hand or automatic ratchet as desired, and an automatic stop is incorporated and can be set to grind any thickness desired. The ratchet wheel is graduated and one tooth movement lowers the head 0.0002 in. The elevating screw for operating the wheelhead passes through an adjustable split bronze nut, making it possible to take up any wear. The weight of the column and head is carried on ball thrust bearings which are also provided with adjustment for taking up wear. The arm that oscillates the column is held in place by a sliding key, and the movement is obtained by means of a connection through suitable universal joints to a crank provided with the necessary adjusting device for regulating the length of the stroke by a screw operating through the crankpin. This adjustment is by means of a socket wrench which is furnished with the machine, the screw being accessible through the lower door at the front. The crank is operated by means of bevel gears connected directly to a



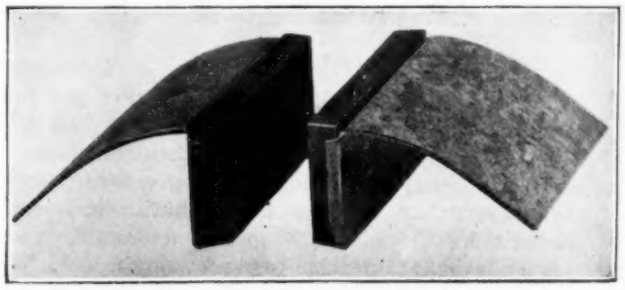
BRISTOL 8-IN. PISTON-RING GRINDING MACHINE

Chuck, 8-in. steel rotary magnetic; size of grinding wheel, 12 x $\frac{3}{4}$ in.; maximum distance from center of wheel to face of chuck, 9$\frac{1}{4}$ in.; vertical feed of wheel, 5 in.; largest swing of dry machine, 17 in.; largest swing of wet machine, 15$\frac{1}{4}$ in.; height of chuck from floor, 42$\frac{1}{2}$ in.; speed of grinding wheel, 1900 r.p.m.; speed of chuck, 180 r.p.m.; number of strokes per minute of grinding wheel across face of chuck, 4.8, 9.6, 14.4 or 19.2 per minute; revolutions of countershaft, 400; tight and loose pulleys on countershaft, 8 x 3 in.; floor space, 42 x 26 in.; over-all height, 63 in.; net weight, 1300 lbs.

four-speed change gear box operated through the lever at the left side of the machine. The chuck is mounted on a vertical spindle made of crucible steel and running in bronze bearings, the thrust being carried on hardened-steel friction rings, this method of construction automatically compensating for any wear. The chuck spindle is driven through a cone clutch and pulley placed between the main bearings, the clutch being operated by a lever placed at the side of the frame. The clutch pulley is driven by belting over idlers to the countershaft. The machine shown in the illustration is for dry grinding, but a machine for wet grinding can be furnished if desired.

Frey Fiber Vise Jaws

The fiber vise jaws shown in the illustration are being marketed by Henry Frey, 337 Gould Ave., N. S., Pittsburgh, Penn. Each jaw is made in two pieces,

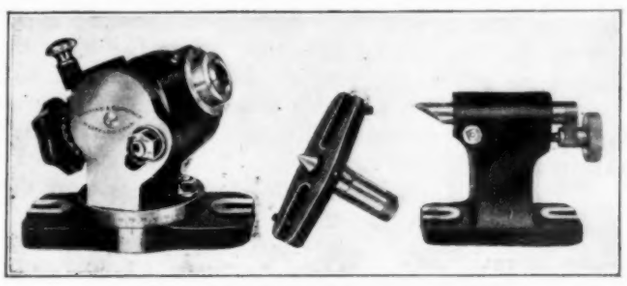


FREY FIBER VISE JAWS

a pocket of galvanized iron fitting over the jaw and a fiber inset that can easily be removed and replaced in case of wear or in case it is desired to insert a face of some soft material, such as leather, for very delicate work.

Whiting & Comstock Semi-Universal Dividing Head

The semi-universal dividing head shown in the illustration is intended particularly for use on hand-milling machines and is a recent product of Whiting & Comstock, 32 Union Place, Hartford, Conn. The centers will swing work up to 8 in. in diameter and the head is shown tipped up slightly with a collet in place in the spindle. The device is intended for either manufacturing or toolroom needs, the head swiveling 180 deg. in a horizontal plane, 90 deg. each side of the center line, and from 30 deg. above the center line to 10 deg. below. The spindles are hardened and ground to size, and all parts subject to wear are heat-treated. The parts are



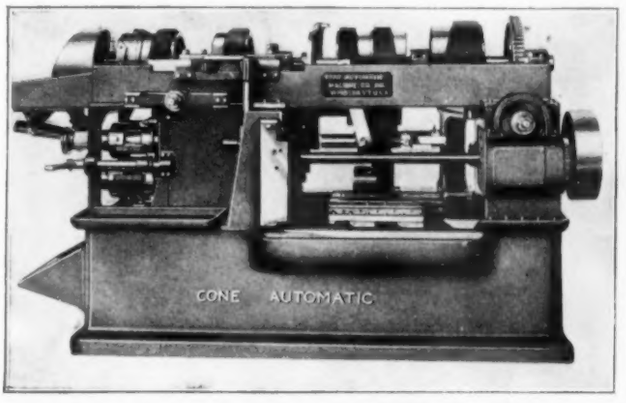
SEMI-UNIVERSAL DIVIDING HEAD

Swing on centers, 8 in.; swivel of head, 90 deg. each side of center line on base, 30 deg. above center line and 10 deg. below; maximum collect capacity, ¾ in.

made interchangeable so as to facilitate repairs in case of breakage. A keyway is cut in the under side of the base and open-ended holes are provided for fastening to the machine table. Standard equipment includes headstock, tailstock, head center, ¾-in. collet, four binder bolts and index plate with 24 divisions.

Cone 3½-Inch Automatic Four-Spindle Screw Machine

The Cone Automatic Machine Co., Windsor, Vt., has just placed on the market a new four-spindle automatic screw machine that is similar to the one described on page 741, Vol. 47, except that it will handle work of



CONE 3½-INCH AUTOMATIC FOUR-SPINDLE SCREW MACHINE

Capacity, work from 1½ to 3½ in. in diameter and up to 7 in. long; floor space, 11 ft. x 5 ft. 6 in.; height, 5 ft. 6 in.; weight, 15,000 lb.

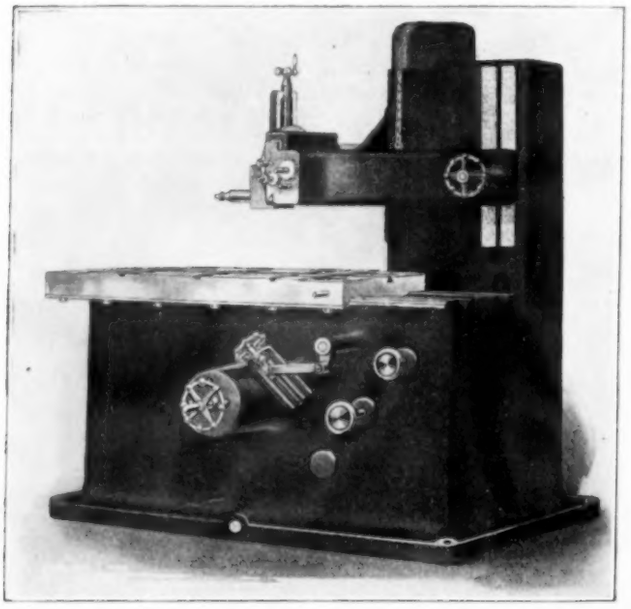
considerably larger size. The present machine is designed for work from 1½ to 3½ in. in diameter, with a length up to 7 in. On the smaller machine cutting off is possible on one spindle only whereas on the newer and larger machine, cutting-off operations can be carried on simultaneously on two spindles, a feature that is desirable on certain classes of work. The machine is of double-bed construction, one bed placed over the other and separated by spacers. The upper bed carries much of the mechanism which makes for accessibility, it being possible to remove the entire camshaft by simply removing the bearing caps.

Kinite Cast Tool Steel

Kinite tool steel, which can be cast to suit the shape of tool or die desired and which is said to possess the unusual quality of not changing shape or size during hardening is a new product that is now being marketed by the Kinite Co., Milwaukee, Wis. The steel is cast in specially prepared molds and it is stated that it does not elongate under tensile stress or decrease in cross-sectional area, retaining its shape and size until the breaking point is reached. The steel contains no tungsten, is said to be very uniform and close-grained, has high heat-resisting qualities, and does not scale in the fire. It is stated to be particularly desirable for punches and dies, and that a large percentage of the labor usually involved in die construction is obviated by the manner in which it is cast. Kinite can be annealed and rehardened many times, without losing its properties and is annealed and hardened at a temperature of about 1840 deg. F.

The Coulter Toolroom Open-Side Planing Machine

The coulter toolroom open-side planing machine illustrated has been placed on the market by the Automatic Machine Co., Bridgeport, Conn. It combines the features of a planing and a shaping machine and is particularly adapted for toolroom work and the manufacture of jigs. All driving shafts are equipped with



COULTER TOOLROOM OPEN-SIDE PLANING MACHINE

Table travel, 0 to 24 in.; table to crossrail (when up), 16 in.; crossrail traverse, 20 in.; vertical tool travel, 6 in.; length of table, 46⅛ in.; width of table, 17½ in.; thickness of table, 3½ in.; distance between pockets, 32⅛ in.; three T-slots for bolts, ⅝ in.; height from table to floor, 36 in.; length of bed supporting table, 53 in.; center to center of ways, 11 in.; length of saddle on crossrail, 14 in.; diameter of swivel head, 10 in.; speed changes for each stroke, 4; horizontal feeds up to ⅛ in.; vertical feeds, ¼ in.; high-speed gear ratio, 6 to 1; low-speed gear ratio, 24 to 1; revolutions of countershaft, 350; single driving pulley, 20 in. x 3 in.; weight, net, 4600 lb.; weight, crated, 5200 lb.; weight, boxed for export, 6100 lb.; dimensions boxed for export 50 in. wide, 76 in. high, 68 in. long; cubic feet, 150.

S.K.F. ball bearings and the sliding gears are easily shifted. The crossrail is raised by rack and pinion from the front, and is counter-balanced. The different speed changes make possible the choosing of the proper speed for the material to be cut and the open side adds to the convenience of securing and observing the work. It is claimed that construction, workmanship and material are well up to the standard required. The bed is cast in one piece and the platen is of liberal dimensions, well ribbed and scraped and gibbed to the bed. The vertical column to which the crossrail is fitted is of heavy section and the bearing surfaces for the sliding parts are ample in extent. Ease of operation and handling is claimed to be one of the strongest features.

Proposed Modification of Screw Threads

Numerous commentaries have been written on the advantages of standardization of engineering productions for domestic use. The theme has grown until today the topic is international standardization and the question becomes one involving the consideration of manufacture in all countries; also what changes may be made without disrupting business.

Those versed in screw-thread matters have from time to time expressed themselves regarding the shortcomings of the Sellers form of thread, particularly in the finer pitches. Among those are L. D. Burlingame, Elwood Burdsall, E. H. Ehrman, F. O. Wells and E. T. Bysshe. The consensus of opinion has been that the crests and roots of screw threads should be flattened to a greater extent than in the U. S. Standard thread.

Suggestions have been made for a form of thread flattened more than the U. S. S. thread and which might serve as a basis for an international standard. Fig. 2 shows a form suggested by E. Burdsall and Fig. 3 one suggested by Messrs. Bysshe and Uhrman. The strength at the root of the male member is the same in both.

The diagrams suggested are basic and do not include such details as crest or root clearance, depth of engagement, etc. They lend themselves well, however, to the application of liberal clearance and tolerance without reducing the depth of engagement below that in some of the existing standard profiles.

The Standard Pitch

Assuming a standard pitch it appears that the following conditions must be met: A standard thread profile must (1) not be greater in depth than the shallowest existing thread; (2) be equal or be greater in depth of engagement than the least depth obtainable in any of the existing threads; (3) specify a crest or root clearance adequate to provide for tool wear in manufacture and for service; (4) be equal or better than existing profiles in withstanding mistreatment; (5) permit a latitude in the shape of the tool crest; (6) not be more difficult of production in either tool, gage or product than in any of the present systems; (7) not make the pitch diameter less than does any existing thread profile; (8) the elements of the thread profile must be the same or the difference must be within the commercial tolerance allowed if internationalism is to be considered; (9) the screw must have equal or greater strength.

Having in view these axioms we must consider the principal systems now in use. There are the U. S. Sellers and Whitworth systems, both of which have admitted disadvantages, the leading ones are shown as follows:

U. S. S. Root.—This is admitted to be too narrow, especially in the finer pitches, and the truncation triangle too small to secure a stable crest in the tool or to obtain adequate root clearance in the product.

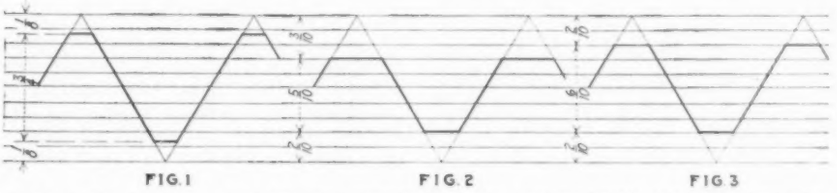
Whitworth Crest.—The depth of engagement is needlessly reduced by at least 0.9 of the height of the rounded crest. The apparent advantage of the rounded crest to withstand marring in handling is offset by the difficulty in accurately producing it in the tool, gage and in the product, and in varying it sufficiently to provide adequate clearance or even necessary tolerance without reducing the depth of thread bearing in a greater ratio.

Whitworth Angle.—An angle of 55 deg. is more difficult to reproduce than the U. S. S. 60-deg. angle.

U. S. S. Crest.—While this crest may not hold its theoretical shape in the tool so well as does the Whitworth crest the cause may not be entirely due to profile and in all probability it is due partly to its relative nar-

rowness. On the other hand its production both in the tool product and the gage is attained and maintained with much greater facility than is the shape of the Whitworth crest.

The modified form of thread suggested by Mr. Burdsall has an increased area of 17, 19 and 24 per cent. respectively for ¼-, ⅜- and ½-in. bolts, and under test has shown an increased strength at the root varying between 11 and 12 per cent. None of these bolts failed by stripping.



FIGS. 1 TO 3. U. S. STANDARD THREAD AND SUGGESTED MODIFICATIONS

Fig. 1—U. S. Standard thread. Fig. 2—Type of thread suggested by E. Burdsall. Fig. 3—Type of thread suggested by Ernest T. Bysshe and Edwin Ehrman.

The form of screw thread used on the well-known Liberty engine furnishes an excellent example of the possibilities and advantages that are to be gained through a greater truncation than that obtaining in the Sellers thread.

At a meeting of the gage committee of the British Engineering Standards Association in September, 1917, a modified form of thread was proposed having the thread truncated slightly at the crest and slightly deepened at the root, the angle of thread and the effective diameter to remain the same. Arrangements were made with a few manufacturers to make sample screws of this modified form of different metals and to forward a report.

Owing to the fact that the British manufacturers were then in the stress of high production a thorough trial was not possible, and the committee, as a result of the reports received, made the following recommendations:

"It was undesirable to recommend to the designs department the adoption of this flattened form of thread as a compulsory measure, but that tolerance of large amount might be given at crest and root.

"See C. L. 4102, British Engineering Standards Association."

All authorities have agreed that the element governing the fit of a screw is that the engagement must be as much as possible on the side of the thread only and that the crest and root must be clear.

Experience has shown that the sharp V-thread is impossible to produce because the point of the tools wear so rapidly, producing a screw which will only interchange with difficulty.

The U. S., or Sellers, thread is a modification of the sharp V-thread and overcame the low-production manufacturing difficulties of the day now passed.

In this article it has been shown that engineers in widely separated localities have developed independently the same idea and the feasibility of modified threads, has been demonstrated by the Liberty engine. Therefore is it not possible that the proposed modified screw thread contains the fundamental characteristics for modern large-production manufacture and for international agreement?

Great progress in individual standardization of screw threads has been made by the manufacturing countries of the world, but the master mind always considers the future and introduces these questions: Has the best form of screw thread been adopted? When definitely promulgating standards, should other manufacturing countries be considered? After the recent stress of high production, can we complacently look on and consider the science of manufacturing screws thoroughly understood, and further progress impossible? It seems illogical to suppose that the modern engineer will answer affirmatively to the first and third questions. The National Screw Thread Commission is about to publish a tentative report and recommendations on screw-thread form, pitches, classification and gaging. This report considers only the form of thread in use in the United States, but since it is tentative the merits of a modified form of thread may be considered, as the door to International standardization is not closed.

Making Specifications Too Specific

BY J. CONKLIN

We make taps, dies, hobs, and kindred tools for the market, and we have some trouble by reason of customers specifying exact theoretical sizes in respect to outside, pitch, and root diameters when ordering V-threads. We must in each case write back and tell the customer that we cannot work to his figures but will hold to them as closely as practical.

This causes delay and hard feelings on the customer's part for he feels that anybody ought to know that theoretical V-thread depths cannot be made, but experience with these customers has taught us to question this point every time because whenever the pitch diameter is specified and worked to, a micrometer will show the outside diameter to be small and the customers will reject the tools.

Of course figures on drawings must check and be exact but theoretical depths or figures for V-thread forms should be so marked on orders and blueprints. For example: ½-in. 12-pitch V-thread tap, ½-in. OD., 0.4278 P.D., 0.3556 R.D. If the pitch diameter is to be maintained then the outside diameter will be 0.4945 in. instead of ½ in. This order could be changed to read "nominal size ½ in. P.D. 0.4278, theoretical R.D. 0.3556 and the order would not be held up. All theoretical figures for V-threads or grooves should be marked "theoretical" and the work will then be made as nearly as possible to this figure.

This applies not only to the 60-deg. V old-style machine screws but to Harvey grip-thread, dovetails, or any other sharp V-form.

Nuts Castellated While You Wait

BY ROBERT H. SCHAFER

If you want a castellated nut in an emergency and none is at hand, put two blades together in your hack-saw frame and saw the necessary slots across the back of the nut. This will make a slot wide enough to take a $\frac{1}{16}$-in. cotter pin, and can be done in less than the time necessary to select a milling cutter.

Sparks from the

Great Increase in Number of Motor Trucks

There Are 500,000 Motor Trucks in Use Today and in Ten Years There Will Be Over 22,000,000 It Is Reported

Ten years ago the number of motor trucks in use was but 4000. Today there are between 400,000 and 500,000, according to James P. Nash, office engineer, State Highway Department, Austin, Tex. Mr. Nash points out: "There is no reason why the number of trucks should not increase next year in the same ratio as in the past. If the number of motor trucks increases in the next ten years in the same ratio as in the past ten years, there would be over 22,000,000 motor trucks in use in the United States by 1929.

"The motor truck should be regarded as a public utility, regardless of who operates it. The motor truck came into existence to get food and supplies to people. To add to the cost of motor transportation is to increase the cost of living. The highways of the country are inadequate for present needs. Their capacity must be doubled to meet the requirements of the next year or two."

"Along what line shall we provide this increase?" asks R. E. Fulton, vice-president of the International Motor Co., manufacturers of Mack trucks. "Shall we double the width of the road and increase its first cost and maintenance 100 per cent.? Or shall we provide a road of sufficient strength to carry vehicles of 100 per cent. greater capacity for a given width of road, the first cost of which would be only 10 to 20 per cent. greater per mile than that of present roads? In view of the fact that 50 per cent. increase in hauling capacity gives a reduction of 15 per cent. in transportation costs, the latter seems the wisest thing to do.

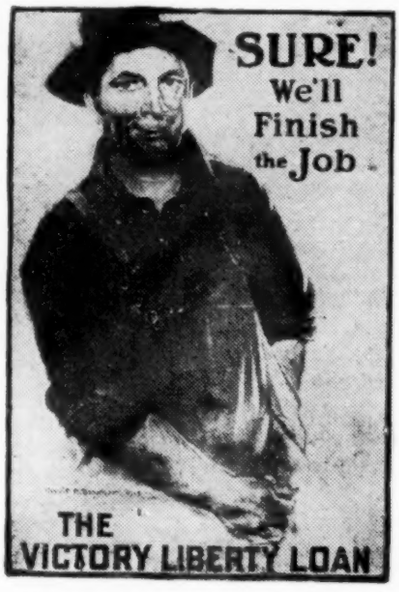
"Money spent to build roads according to present standards is money thrown away. We must build for the future and estimate now what the future demands."

* * *

Britain Making Great Strides in Commercial Aviation

The civil aëronautical position in Great Britain is hailed by the British press as being "far more advanced than in any other country," the American Chamber of Commerce in London reports. When General Seely, Under Secretary for Air, presented the air estimates for 1919-20 to the House of Commons recently premier emphasis was laid on the appropriation of £3,000,000 ($15,000,000) for civil aviation research and experiment.

A mail service from Cairo to India is definitely to be inaugurated. The air route has already been surveyed, and the route from Cairo to the Cape is being surveyed. Both in the British Isles and in the possessions, aërodromes are to be established at suitable spots with full equipment of meteorological instruments, sound and light signals, balloons and aërial buoys, wireless telegraphy and telephone equipment.



Already cargo planes are in sight. A huge British seaplane of novel type, equipped with five Rolls-Royce motors, has already had its initial flight, carrying six tons at 100 miles per hour. Another with a carrying capacity of nine tons is being experimented with. The remarkable British military achievements in the air are expected to be completely eclipsed by the development of the airplane as a commercial and economic factor.

* * *

Colonel Baker to Head Steel Company

The American International Steel Corporation has announced that Lieut.-Col. M. G. Baker, former assistant general manager of sales of the Cambria Steel Co., and more recently connected with the United States Ordnance Department, has been appointed president of the corporation. Colonel Baker succeeds Edward M. Hagar, who died more than a year ago. Since then the business of the American International Steel Corporation has been in charge of Morris Metcalf, vice president, who still remains in that position. The company is a subsidiary of the American International Corporation.

Market for Machine Tools in Sweden

Machine tools are made in Sweden in considerable quantities. During the war a number of firms were established for the purpose of manufacturing machine tools and like products to fill the need of the market, which was greater than usual on account of the inability to import from such large tool-making countries as the United States, Great Britain and Germany. Some of these firms will be unable to compete in this market after normal conditions have been reëstablished, because of the higher average cost of production here. There are indications of greater efforts on the part of the machine-tool manufacturers of Sweden to cultivate the export market; but, despite these efforts, the domestic market offers opportunities for American exporters, as the American tool has earned a high reputation. It will be some time, in all probability, before the German machine tools can reënter this market; therefore, unless tariffs or other regulations are imposed, there should be better opportunities for American machine tools in Sweden than heretofore.

* * *

Association of Tin Plate Manufacturers

The recently organized Association of Tin Plate Manufacturers has headquarters in Room 909, Oliver Bldg., Pittsburgh, Penn. The association includes practically all the independent tin-plate mills in the country. The American Sheet and Tin Plate Co. is not a member, because it is against the policy of any subsidiary of the United States Steel Corporation to join an organization of any kind. The officers of the new association are E. T. Weir, Weirton Steel Co., Weirton, W. Va., president; E. R. Crawford, McKeesport Tin Plate Co., McKeesport, Penn., vice president; E. T. Sproull, Trumbull Steel Co., Warren, Ohio, treasurer; and George D. McIlvain, secretary. The board of trustees consists of E. T. Weir, E. R. Crawford, Philip Schaeffer, Jones & Laughlin Steel Co.; John Duncan, Wheeling Steel and Iron Co., and E. T. Sproull.

* * *

Exhibition of Railway Appliances

The Railway Master Mechanics' Association and the Master Carbuilders' Association have combined as the mechanical section of the American Railway Association and will hold a convention and exhibition of machine tools and railway appliances at Atlantic City, June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

World's Industrial Forge

By E.C.Porter, News Editor

Expansion of Japan's Trade During the War

A detailed trade study of Japan for the years 1913 to 1917 just issued by the United States Tariff Commission indicates striking changes in the commerce, industry and the financial position of that country during the war period.

Japan's total trade rose from $680,500,000 in 1913 to $1,319,000,000 in 1917, an increase of 94 per cent. The figures for exports and imports were: Exports in 1913, $316,000,000, and in 1917, $801,500,000; imports in 1913, $364,500,000, and in 1917, $517,500,000. For the four years 1910 to 1913 the imports normally exceeded the exports by an annual average of $32,500,000. In 1914 there was still a slight balance in favor of imports; in the three years 1915-17 the excess of exports over imports averaged $185,500,000. The excess in 1917 was $283,500,000.

* * *

Metallurgic Industry Prosperous in Switzerland

The metallurgic industry in Switzerland, says Consul Phillip Holland, has made satisfactory progress during the war, notwithstanding the difficulties under which it operated. Until 1916 operations went on smoothly—Germany supplying raw materials and coal—and markets were found in all countries. After 1916 Germany limited its exports of raw materials to Switzerland to those needed for the manufacture of war orders for the central powers. After this restriction some raw materials were imported from England and operations continued. The following summary of exports of machinery gives a general idea of the success of this Swiss industry:

Total machinery exports, including machine tools, motors, locomotives, boilers, printing equipment, agricultural implements and machinery for the manufacture of various foods, textiles, building materials, etc., for the first nine months of 1918 were valued at $22,892,309, as compared with $22,022,844 for the corresponding period of 1917. For the whole of 1917 the value of exported machinery was $29,229,850, while in 1913 it totaled only $19,053,925. Exports of machinery reached their maximum during the war in 1916, when they were valued at $29,941,634.

Attention should be called to the fact that in 1917 the export of machine tools to the value of more than 45,000,000 francs ($8,685,000) was for the manufacture of munitions.

There was a heavy demand, both local and foreign, for all kinds of electrical machinery and equipment. The electrification of small railways and the building of hydro-electric plants were taken in hand very actively.

The northern Swiss are expecting the machine industry to retrieve for them the economic losses which are likely to be sustained after the war by the dye and ribbon industries. For the future much will depend upon their being able to obtain raw materials—coal, iron and steel. They will likely turn to France, England and the United States for materials formerly imported from Germany. The home market will probably be a good field for machine products because of the general electrifying of traffic and industries.

Convention of Foundrymen Will Meet in Philadelphia

Invitation Will Be Extended To Foundrymen and Industrial Engineers of England, France, Italy, and Other Countries

Secretary C. E. Hoyt, of the American Foundrymen's Association, 111 West Monroe Street, Chicago, announces that Philadelphia, the birthplace of the association, has been selected as the place of the 1919 convention and exhibit, which will be in the week of Sept. 29. The organization meeting was held in Philadelphia in June, 1896, and in 1907 Philadelphia again entertained the foundrymen of the country in their annual convention, this being the first convention in which any considerable exhibit of foundry equipment was made.

Much of interest to foundrymen has developed in the Philadelphia district in the 12 years since the last meeting there, including the great shipyard at Hog Island, the new foundries at the League Island Navy Yard and the foundries of the Westinghouse company at Essington.

Of special significance in connection with the next convention is the plan of the officers of the association for an international meeting. Invitations will be extended to foundrymen and industrial engineers in England, France, Belgium, Italy and other European countries, as well as in South America and Australia, to come to Philadelphia in September. The fourteenth annual foundry exhibit will be held in the week of the Philadelphia convention in the exhibition hall of the Philadelphia Commercial Museum. This building is located on the Schuylkill River in West

The Careless Machinist's Creed and His Reasons

By N. O. Good, in *Deane News*.

1. I believe in using a monkey wrench in preference to a hammer because a monkey wrench looks better when it is all battered up. And besides, that is what it was made for.

2. I believe in borrowing other men's tools in preference to buying some of my own. This is a good method of cutting down the high cost of living and saves me carting around a heavy tool chest in my travels.

3. I believe in oiling my machine once every six months at least. This is a great saving to the company, as oil costs something these days.

4. I believe in keeping the shop tools in a heap on the floor instead of using the locker provided for this purpose. In this way they can have their cutting edges ruined far more quickly than by using them on the work.

5. I believe in wiping off chips with my fingers in preference to using a stick or brush provided by the company, because the former is a most ancient custom and takes the place of a surgical operation.

6. I believe in keeping tools under the planing machine table and in reaching for them while the table is running. This breaks the monotony of life and gives opportunity for some clever gymnastics.

7. I believe, when running my shaping machine, in having my slide rest projecting far enough to hit the bed on the back stroke. This is great fun and provides employment for the repair gang who might otherwise be out of a job.

8. I believe in wearing loose or torn overalls and a long flowing necktie, when running a high speed lathe or drilling machine. This is also a very ancient custom and a suitable dress for machine-shop work.

9. I believe in mixing brass, babbitt, steel and iron chips in the pans. This mixture always looks well and proves fascinating employment to the man who has to separate them.

10. I believe in using a long-handled wrench in tightening a three-quarter bolt and much prefer a half nut to a nut on the whole depth. This ruins the bolt at once instead of prolonging its life indefinitely.

11. I believe in blaming the night man when anything is lost or goes wrong with my machine. He is not here to contradict me, so I can explain it all to the boss satisfactorily.

12. Finally, I believe in abiding by all the rules and regulations of the company to the best of my ability when the boss is around.

Philadelphia at Thirty-fourth Street below Spruce, only five blocks from the West Philadelphia yards of the Pennsylvania Railroad. The building has a private Pennsylvania Railroad siding for unloading carload shipments. The exhibition hall will be the largest ever occupied by the display of foundry equipment, having 88,000 sq.ft. all in one room on the ground floor. The floor is of cement. The fact that foundrymen and industrial engineers from other countries are expected at Philadelphia gives the meeting an unusual distinction and the expectations are that the exhibits will be more numerous and more representative than at any previous meeting. The program of papers for the session of the American Foundrymen's Association is expected to measure up to the past standards of the association.

* * *

Training and Employment for Soldiers

Every disabled soldier and sailor should know that the Government is resolved to do its best to restore him to health, strength and self-supporting activity.

That until his discharge from hospital care the medical and surgical treatment necessary to restore him to health and strength is under the jurisdiction of the military or naval authorities.

That the vocational training which may be afterward necessary to restore his self-supporting activity is under the jurisdiction of the Federal Board for Vocational Education.

That if he needs an artificial limb or other orthopedic or mechanical appliance the Bureau of War-Risk Insurance supplies it free upon his discharge and renews it when considered necessary.

That if, after his discharge, he again needs medical treatment on account of his disability the Bureau of War-Risk Insurance supplies it free.

That any man whose disability entitles him to compensation under the War-Risk Insurance Act may be provided by the Federal Board with a course of vocational training for a new occupation.

That the Government strongly recommends each man who needs it to undertake vocational training and put himself under the care of the Federal Board, but the decision to do so is optional with each man.

That if his disability does prevent him from returning to employment without training and he elects to follow a course of vocational training provided by the Federal Board, the course will be furnished free of cost, and he will also be paid as long as the training lasts a monthly compensation equal to the sum to which he is entitled under the War-Risk Insurance Act or a sum equal to the pay of his last month of active service, whichever is the greater. But in no case will a single man or a man required by his course of instruction to live apart from his dependents receive less than $65 per month, exclusive of the sum paid dependents; nor will a man living with his dependents receive less than $75 per month, inclusive of sum paid to dependents.

That if his disability does not prevent him from returning to employment without training and he elects to follow a course of vocational training provided by the Federal Board, the course will be furnished free of cost to him, and the compensation provided by the War-Risk Insurance Act will be paid to him, but no allowance will be paid to his family.

That in addition to the above the family or dependents of each disabled man will receive from the Government during his period of training the same monthly allotment and allowance as that paid prior to his discharge from the army or the navy.

That upon the completion of his course of training he will continue to receive the compensation prescribed by the War-Risk Insurance Act so long as his disability continues.

That in nearly every case, by following the advice and suggestions of the Federal Board, he can either get rid of the handicap caused by his disability or acquire new powers to replace any that may have been lost.

That if he is willing to learn and to take advantage of the opportunities to increase his skill offered him he can usually get a better position than he had before entering the service.

That if he fails to take advantage of these opportunities he will find himhelf badly handicapped when he is obliged to compete with the able-bodied men who come back to work after the war.

That the Federal Board, through its vocational experts, will study his particular disability and advise him as to the proper course to pursue and give him free training for the occupation best suited to him.

That on the satisfactory completion of his training the Federal Board, through its employment service, will assist him to secure a position.

That public authorities and other large employers will in many cases, at least, give the disabled soldiers and sailors preference when filling vacant positions, provided they possess the training necessary to fill them.

All disabled soldiers, whether in or out of the hospital, should address their communications either to the Federal Board for Vocational Education, Washington, D. C., or to the district office of the Federal Board of the district in which they are located. The district offices of the board are located at the following points respectively:

District No. 1—Maine, New Hampshire, Vermont, Massachusetts and Rhode Island. Office in the Tremont Building, Boston, Mass., Room 433.

District No. 2 — Connecticut, New York and New Jersey. Office at 280 Broadway, New York, Room 711.

District No. 3 — Pennsylvania and Delaware. Office at 1000 Penn Square Building, Philadelphia, Penn.

District No. 4—District of Columbia, Maryland, Virginia and West Virginia. Office at 606 F St., N. W., Washington, D. C.

District No. 5 — North Carolina, South Carolina, Georgia, Florida and Tennessee. Office in the Candler Building, Atlanta, Ga., Room 1404.

District No. 6—Alabama, Mississippi and Louisiana. Office at 822 Maison Blanche Annex, New Orleans, La.

District No. 7 — Ohio, Indiana and Kentucky. Office at 906 Mercantile Library Building, Cincinnati, Ohio.

District No. 8 — Michigan, Illinois and Wisconsin. Office at 110 South Dearborn St., Chicago, Ill.

District No. 9—Iowa, Nebraska, Kansas and Missouri. Office at 517 Chemical Building, St. Louis, Mo.

District No. 10 — Minnesota, North Dakota and South Dakota. Office in the Metropolitan Bank Building, Minneapolis, Minn., Room 742.

District No. 11—Wyoming, Colorado, New Mexico and Utah. Office at 909 Seventeenth St., Denver, Colo.

District No. 12—California, Nevada and Arizona. Office at 997 Monadnock Building, San Francisco, Calif.

District No. 13 — Montana, Idaho, Oregon and Washington. Office in the Central Building, Seattle, Wash., Room 539.

District No. 14—Arkansas, Oklahoma and Texas. Office at 810 Western Indemnity Building, 1000 Main St., Dallas, Texas.

Your Foreign Business Agent

How can we obtain export business? is the question now being asked by many American manufacturers. The desirability of increased foreign trade is keenly appreciated. Its possibilities are being insistently emphasized. There is an eagerness to acquire accurate knowledge concerning it. But some, at least, of our exporters or prospective exporters may not realize that even the least important among them already has representatives working for him in all parts of the world.

From these special representatives reports are received giving complete descriptions of the life and customs of the people in foreign lands, together with the class of commodities they purchase, the prices and the terms. Accounts are given of the home and foreign competition, the character of domestic labor and its cost, the most effective methods of entering the market. Precise and detailed import figures are furnished. Thus the American merchant is enabled to know definitely in advance the conditions that he will have to meet in obtaining foreign trade. The shorter reports of this nature appear in a daily paper, *Commerce Reports*, while the longer, more comprehensive ones are published in special books and pamphlets.

This service is maintained by the Bureau of Foreign and Domestic Commerce, Washington, D. C., which is the agency of the United States Government for promoting trade between this and other countries

Personals

GEORGE C. RAMER, formerly with the St. Louis office of the Oliver Machinery Co., is now with the sales offices at Chicago, Ill.

W. C. CONYER has resigned his position with the Liberty Steel Products Co., and is now associated with M. A. Palmer Co., of Boston, Mass.

G. C. CONKLIN, who has for many years been connected with the factory of the Oliver Machinery Co., Grand Rapids, Mich., has recently been appointed district manager of the new Chicago office.

D. H. DIEFENDORF, formerly chief engineer and director of the New Process Gear Corporation since 1899, has joined the Weekes-Hoffman Co., of Syracuse, N. Y., as vice president and general manager.

WILLIAM H. RANDALL, formerly superintendent of the maintenance and distribution department of the Toronto water works, has been appointed manager director for the new Canadian office of the Neptune Meter Co. of New York.

HAROLD C. BEMENT has been placed in charge of the electric furnaces at the new plant of the Onondago Steel Co., Inc., at Eastwood, near Syracuse, N. Y. Mr. Bement was formerly melter foreman at the Government Arsenal at Watertown, Mass.

J. D. MOONEY, recently released from service after serving as a captain with the 309th Ammunition Train, 84th Division, is now with the General Motors Corporation, New York City. He was formerly with the Hyatt Roller Bearing Co., Industrial Division, Newark, N. J.

CHAS. EISLER for several years with the Westinghouse Lamp Co., Bloomfield, N. J., as chief designer and engineer, has resigned. He is now with the newly formed Save Electric Corporation, Bush Bldg., Brooklyn, N. Y., as superintendent of the equipment designing and development departments.

DUDLEY H. COHEN, formerly vice-president of the William Brewster Co., and assistant treasurer of the Trojan Tool Corporation, has sold his interest in the William Brewster Co. in order to devote all his time to the Trojan Tool Corporation, in which company he has been elected treasurer and general manager in full charge of production and sales.

SVEN SPELLING, mechanical engineer, is returning to Copenhagen to open offices and manage the Scandinavian branches of the Parker Co. Mr. Spelling has spent the last few years in America, studying machinery and familiarizing himself with the American methods of manufacture. Prior to his connection with the Parker Co., he was associated with A/S Tuxham, Copenhagen and also the R. Hoe & Co., New York and the Bartlett-Hayward Co., Baltimore, Md.

Good Field for Exporters in Central America

According to Gonzalo Boza, a Central American importer now in New York, the American exporter is not taking proper advantage of the opportunities offered by the countries of Central America. During an interview at the offices of the American Manufacturers' Export Association, Mr. Boza explained how necessary it is for merchants in this country to familiarize themselves with the requirements, interests and customs of the Central American countries.

After pointing out the rich natural resources of the five republics of Central America, Guatemala, Salvador, Honduras, Nicaragua and Costa Rica, he discussed the methods which must be adopted by exporters seeking commercial relations with these countries, emphasizing the importance of courtesy and thoughtfulness in corresponding with customers in Central America.

Mr. Boza directed special attention to the importance of sending samples, small pamphlets or catalogs, with a description and illustrations if possible of the merchandise printed in good Spanish, to importers in the Central American countries.

* * *

Sale of Government Equipment Being Made

The following equipment and available hardware is for sale by the Government. Any further information may be had through communication with the nearest District Bureau of Aircraft Production, Attention Material-Disposal Section:

Thirty-nine gross ⅜-in. No. 2 flat-head bright wood screws; three gross ½-in. No. 4 flat-head bright wood screws; 21,379 gross ½-in. No. 4 flat-head bright wood screws; 79,396 gross ¾-in. No. 6 flat-head bright wood screws; 61,545 gross 1-in. No. 2 flat-head bright wood screws; five gross 1-in. No. 3 flat-head bright wood screws; 73 gross 1-in. No. 5 flat-head bright wood screws; 24 gross 1-in. No. 6 flat-head bright wood screws; 119,-682½ gross 1-in. No. 8 flat-head bright wood screws; nine gross 1¼-in. No. 7 flat-head bright wood screws; one gross 1¼-in. No. 9 flat-head bright wood screws; 48 gross 3½-in. No. 14 flat-head bright wood screws; 60 gross 2½-in. No. 12 flat-head bright wood screws; 17 gross 2-in. No. 9 flat-head bright wood screws. These are all located at the Grand Rapids Airplane Co., Grand Rapids, Mich., and are in first-class condition.

* * *

Erratum

On page 678 the statement was made that manganese dioxide is used to retard the release of oxygen when heated in a retort with chlorate of potash. This is an error. The manganese dioxide is used because it enables the chlorate of potash to more readily give up its oxygen and at lower temperature than without it.

Business Items

The Allied Machinery Co. of America has removed its main offices in New York to 51 Chambers St., where it has taken the entire eighth floor.

The Hartford Special Machinery Co., Hartford, Conn., is reconstructing its plant to manufacture a patented three-spindle vertical automatic internal grinding machine for production purposes.

Chas. F. Ames & Co. Ltd., 90 West St., New York, has been appointed to act as the New York sales department of the Platt Iron Works, of Dayton, Ohio, manufacturer of pumping and power-plant equipment.

The Holt Manufacturing Co., Peoria, Ill., has returned to the commercial field after having been virtually out of the market for four years, due to the contracts with the Allied nations and with the United States Government. During this period the Holt plant was almost doubled and $1,000,000 was spent on the plant and new equipment.

The Ludlum Steel Co. of Michigan has taken 7500 ft. of floor space in the Siegel Building, Detroit, and has fitted it up with warehouse and offices. This company will carry a stock of high-speed and carbon-tool steel with sawing facilities up to 10 in. in diameter. William A. Edwards is the manager of sales and has charge of the offices and warehouse.

E. I. du Pont de Nemours & Co., Inc., announce the organization of E. I. du Pont de Nemours Export Co., a subsidiary corporation, created for handling its foreign business. The main offices of the new company will be located on the 17th floor of the Equitable Building, 120 Broadway, New York, with branches in San Francisco, Mexico City, London and Rio de Janeiro.

The Sullivan Machinery Co. has recently organized a foreign-trade department with F. W. Copeland, formerly attached to the St. Louis office, as manager, with headquarters at Chicago. The purpose of this department will be to coördinate and assist the work of the foreign branches and agents of the company, and to devote particular attention to correspondence and inquiries from abroad.

Obituary

B. C. KENYON, purchasing agent for the Crocker Wheeler Co., died at his home, East Orange, N. J., on Apr. 5.

FREDERICK BECKERT, master mechanic of the Greist Manufacturing Co., died at his home, New Haven, Conn., after a long illness. He had been with the Greist Manufacturing Co. since 1899, starting as foreman of the toolroom, but in a few years was appointed master mechanic.

New Publications

Punches and Dies.—By **Frank A. Stanley.** Four hundred and thirty-four 6 x 9-in. pages; 618 illustrations; fifteen tables; bound in dark cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price, $4.

This book contains an enormous amount of material of interest to the toolmaker, diemaker, tooldraftsman or designer. The large number of illustrations show the latest practice in die making as done in some of the largest and best shops of the country. The detailed drawings shown are especially valuable, and these taken with the photographs of the tools given, will prove of great value to those interested. The presswork of the book is unusually good and adds to the ease with which details of the various tools may be deciphered. The chapters are: Press Tools in General; Blanking Dies; Piercing Tools—Blanking and Piercing Dies; Compound Dies for Blanking and Piercing; Cutting-off Dies or Parting Tools; Shaving Dies and Their Applications; Trimming Dies—Trimming and Shaving; Drawing Dies and Their Action Upon Materials; Combination and Compound Dies for Blanking, Drawing, Forming and Piercing; Bending and Forming Tools; Bending, Forming and Other Dies Applied to Specific Lines of Work; Dies for Embossing, Marking, Riveting, Swaging; Indexing and Transfer Dies; The Sub-press and Its Dies; Punch and Die Standards; Finding the Size of Blanks for Shells and other Drawn and Formed Work; Laying Out and Making Templets and Dies; Locating Holes Accurately in Die Work; Making a Set of Shaving Dies; Some Hardening Principles Applied to Dies. Index.

Trade Catalogs

"Star" Ball Retainers. The Bearings Co. of America, Lancaster, Penn., has recently mailed from its Detroit office, 1012 Ford Bldg., a new issue of its load and data sheets on "Star" ball retainers, which are built for thrust bearings, cup and cone and magneto types of bearings. These lists are made to fit in the S. A. E. date sheet folders, and all who are interested may receive copies of these lists by addressing the Bearings Co. of America.

Floating Chucks and Drills for Drilling Square and Hexagon Holes. Watts Bros. Tool Works, Turtle Creek, Penn. Circular, pp. 8, 3½ x 6 in. This explains and describes the method of drilling square and hexagon holes in steel, iron, brass, aluminum, micarta bakelite, wood, marble, etc. List prices of chucks and drills are given.

Standard Reinforced Spiral Pipe. Standard Spiral Pipe Works, Chicago, Ill. Catalog No. 7, giving list prices of the various sized pipes together with descriptions of the testing, coating and special sheet-steel fittings for pipes manufactured by this company.

Thomson Process, Electric Welding. Thomson Electric Welding Co., Lynn, Mass. This is a loose-leaf folder containing seven bulletins descriptive of light- and heavy-duty butt-welding machines, light- and heavy-duty spot welders, tool welding on high-speed and stellite steels, stationary electric riveters and seam welders. All are profusely illustrated and contain general electric-welding information.

Pinite Rigid Couplings for Line Shafts. Smith-Serrell Co., Inc., 90 West St., New York City. Bulletin No. 102, pp. 4, 6 x 9-in. folder giving sizes and list prices of Pinite rigid couplings.

Malleable Iron. A booklet published by the American Malleable Castings Association, Cleveland, Ohio, and treating of the properties and uses of malleable iron. It will be sent free upon application to the association at Cleveland.

Sheet-Metal Stamping. Bay State Stamping Co., Worcester, Mass. Catalog M., pp. 18, 6 x 3½ in. This is a catalog descriptive of self-closing oil-hole covers, oilers, grease cups, emery-wheel dressers, tools and cutters for turning and trying emery wheels, curtain fixtures and screw-driver ferrules. Sizes and illustrations are given.

Catalogs Wanted

S. Coulange, director of the Journal of the Industrial Alliance, an association of engineers and mechanical designers of Belgium, with headquarters at Rue Bonne Nouvelle, 92, Liége, Belgium, would like catalogs and literature of American machine tools.

F. Lamuché, 8 Rue Montesquieu, Bordeaux, France, would like catalogs of American machine tools and equipment. He would also appreciate the names and addresses of French agents for American manufacturers of machine tools.

The Purchasing Agents' Association of Northern California through its secretary, D. B. Gray, 230 California St., San Francisco, invites manufacturers and dealers to send complete sets of their latest catalogs and trade publications. Catalogs covering particularly machinery, mechanical goods, hardware, iron and steel products, etc., are especially requested.

Vincento M. Marti, Calle Maestro Aguilar No. 18-10, Valencia, Spain, desires the agency and catalogs for American lines of machines such as would be suitable for outfitting small machine shops.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A firm in England desires to purchase lathes for turning vegetable ivory buttons, 2-hole, 4-hole, and 1-hole; and drilling and polishing machines for the manufacture of buttons from vegetable ivory. Reference. No. 29046.

A firm in Spain wishes to purchase emery stones for polishing and sharpening, rapid steel drills, ordinary drills for iron, cutlery, steel for making tools, emery powder, and metal saws. Quotations should be given f.o.b. New York. Funds will be placed in New York bank, or shipments may be made against documents. Correspondence should be in Spanish. References. No. 29056.

A firm in Spain desires to purchase industrial machinery, building hardware, heavy hardware, construction material, electrical machinery, emery stones, and automobile truck tires. Quotations should be f.o.b. New York. Payment, cash against documents. Correspondence should be in Spanish. References. No. 29079.

A commercial agent in Belgium wishes to purchase and to secure an agency for the sale of machine tools, twist drills, and small tools in general. Correspondence may be in English. References. No. 29042.

A man in Switzerland desires to secure an agency for the sale of machinery, electrical apparatus, and tools. References. No. 28975.

A man in Greece desires to purchase galvanized-iron sheets and corrugated-iron sheets, size in meters, two by one thickness; 22 to 28 gage; and solder used in connection therewith. Quotations should be f.o.b. New York. Correspondence may be in English. References. No. 29083.

A merchant in France desires to represent manufacturers and exporters for the sale of locomotives, machinery, and materials for railways, steamships, gas and electrical plants, waterworks, mining, construction work, etc. Correspondence may be in English. No. 28959.

A business man in Norway desires to secure an agency for the sale of electrical motors, transformers, storage batteries, dry cells, wires, cables, resistance alloys, apparatus for cooking and heating, insulators, insulating materials, tapes, and other electrical supplies; also varnish, carbon and metal brushes, metals, transformer and dynamo plates, tools, etc. No. 28960.

A firm in Switzerland desires to purchase and to secure an agency for the sale of automatic numbering machines, stamp pads, and automatic adding machines. Quotations should be given f.o.b. American port. Correspondence may be in English. References. No. 29067.

A commercial agent in France desires to secure an agency for the sale of machine tools, industrial supplies, belts, oils, greases, etc. Correspondence should be in Frtnch. Reference. 28932.

A man in Sweden wishes to purchase machines for paper making, especially hydraulic presses, also those for steel pressing. Reference. No. 29064.

Forthcoming Meetings

American Association of Engineers. Annual meeting has been scheduled for May 13 at Chicago. C. E. Drayer, national secretary, 29 S. La Salle St., Chicago, Ill.

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Railway Association, Mechanical Section, will hold its convention and exhibition at Atlantic City, N. J., June 18-25. Secretary, J. B. Conway, 1841 Oliver Bldg., Pittsburgh, Penn.

American Society of Mechanical Engineers. Spring meeting to be held at Hotel Statler, Detroit, Mich., June 16-19, 1919. Secretary, Calvin Rice, 29 West 39th St., New York City.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

National Foreign Trade Council. Annual meeting at Chicago, Apr. 24-26. O. K. Davis, secretary, 1 Hanover Square, N. Y.

National Machine Tool Builders' Association. Spring convention to be held at Atlantic City, N. J., May 12 and 13, with headquarters at Hotel Traymore. C. Wood Walter, Cincinnati, Ohio, secretary.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridge, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On May 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

United States Chamber of Commerce. Annual convention to be held at St. Louis, April 28, 29 and 30. National headquarters, Riggs Building, Washington, D. C.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.